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MINERAL RESOURCES OF THE UNITED STATES, 1905.

David T. Day, *Chief of Division.*

INTRODUCTION.

The arrangement and scope of this volume are practically the same as in the twenty-one 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.

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, including a summary which gives in condensed form the statistical information recorded in this report.

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.

EXPERT CONTRIBUTORS OF CHAPTERS.

This series of reports was begun in 1883. Its object then, as now, was to present a statement of the known mineral resources of the United States and a statistical statement of the production of these materials and the uses to which they were applied. The Government's official information in regard to the production of various mineral substances had been limited to the statement in the census reports and to occasional fragmentary studies of especial mineral products. In order to bring together in the course of one year an estimate of all of the mineral products of the United States, the cooperation was invoked of those who were recognized as the best experts for each of the mineral industries, and the compilation of the report on each topic was left to such an expert with entire responsibility for the subject treated and under an appointment as special agent with authority to conduct correspondence in this regard and to accept confidential information in the name of the United States Government. There was thus brought together a corps of experts whose experience in the subject assigned to each, supplemented rapidly by the great volume of correspondence with the principal elements of the mineral trades, gave a standard of accuracy and completeness to the reports published in the Mineral Resources which could not have been secured by any other means except by long training of such experts as the Survey might have chosen to develop in its own corps. At that time the study of economic geology in the United States Geological Survey was greatly limited by insufficient appropriations from Congress and by the fact that the training possible for an economic geologist in the leading colleges and in the Geological Survey itself was not sufficient to secure an efficient corps of trained men for studying in any comprehensive way the mineral deposits of the entire country.

The wisdom of the system adopted for the preparation of the reports on mineral resources has been amply proved by the regard in which the reports of the specialists are held. In most cases this work was entered upon by the experts without the possibility of obtaining any such compensation as they would have demanded for private reports. In general, their services have been given practically for an honorarium sufficient only to cover the clerical aid which they were obliged to hire. It is a significant and gratifying fact that many of those whose work has always been of greatest value in effecting a high standard for the Mineral Resources of the United States have remained in charge of their various assignments for more than twenty years—indeed, from the beginning of the series until the present time, and that the work of others was terminated only by death.

First to respond to the request for cooperation in this work was Mr. Charles Kirchhoff, of New York City, then editor of the Engineering and Mining Journal, now editor of the Iron Age. In 1882 Mr. Kirchhoff assumed the responsibility for an annual statement of the production of copper, lead, and zinc. He has continued that work annually for twenty-three years, including the preparation of the reports for the present volume. These reports, more than any others, have been typical of the scope which the Mineral Resources has embraced; they have shown the resources of the United States in copper, lead, and zinc, in so far as developed, and have dealt with the trade in these products. The unfailing patience with which Mr. Kirchhoff has met the requests from the Government, year after year, to continue the preparation of these reports, with the attendant necessity for untiring vigilance in keeping a grasp on all the ramifications of the industries for which he has been responsible, has constituted a monumental piece of scientific endeavor for the Government service. For this he has had no reward other than the credit for his successful results. For years Mr. Kirchhoff has called attention to the sacrifice of time and energy which it has been necessary for him to make in his necessarily active life as editor of the Iron Age, and each year has been induced to continue his work until a system could be developed by which members of the Geological Survey corps could acquire the necessary familiarity with the work to carry it on within the organization itself.

Scarcely less deserving of acknowledgment for his untiring patience and keen perception in the work intrusted to his care have been the services of Mr. George F. Kunz who, since the inception of this report, has prepared each year an essay on the precious stones of the United States. The irregular character of the production of these gems, the fact that in many cases they are by-products of other branches of mining, and the natural desire on the part of many of the producers to conceal the sources from which their gems were obtained, has led to a kind of difficulty in collecting statistics which other statisticians can scarcely appreciate. No one but Mr. Kunz has ever prepared a statement of the gem production of the United States.

Of those who up to the present volume have prepared a report for every year since the beginning of this work is the veteran statistician, Mr. James M. Swank, secretary of the American Iron and Steel Association, who has given strength to the work not only by his admirable reports and his reputation for exactness but by the wise counsel which he has frequently lent to the planning of chapters other than his own.

As is well known to our readers, Mr. Joseph D. Weeks contributed continuously on the statistics of coke, petroleum, natural gas, and other subjects from the beginning until the time of his death.

Another constant contributor who has furnished information concerning the entire Pacific slope of the United States not only for reports compiled by himself but as contributions to the essays of others is Mr. Charles G. Yale. When this series began, Mr. Yale was editor of the Mining and Scientific Press; he has been a representative of the Geological Survey continuously since 1882, and has now become a permanent officer of the organization.

The statistics of iron ore production were intrusted to Mr. John Birkinbine, engineer, of Philadelphia, in 1889. Although Mr. Birkinbine did not begin the collection of these statistics contemporaneously with the series, he nevertheless began a work that was new, inasmuch as prior to 1889 no complete annual canvass of the iron ores of the United States had been attempted. Mr. Birkinbine's position in the mining profession, his knowledge of the charcoal-iron workers, and his reputation as a blast-furnace expert gave much strength to the series. His work, without other compensation than for necessary clerical aid, has continued uninterruptedly until the present time, and this in spite of the sacrifice of time and of the increasing labor involved in keeping track of the enormous growth of the iron-ore industry.

As the possibilities developed, the series has extended more and more into the conditions of occurrence of various of the less-known minerals, such as corundum and mica, which brought to the work Dr. Joseph Hyde Pratt, State mineralogist of North Carolina, and an acknowledged expert, especially in abrasives. His reports on these subjects have covered the entire field from the occurrence of the minerals in the ground and their associations through to the uses which give the products their value in the trades. The information which he has thus made available has several times stretched beyond the limits of this volume into the form of bulletins. Doctor Pratt has now become State geologist of North Carolina and is also giving the benefit of his familiarity with national mineral resources to the Jamestown Exposition as chief of the mining department.

For years Mr. F. H. Oliphant has gathered the information as to new petroleum fields in the United States, and has prepared the report upon petroleum from statistics gathered by the Survey through Miss Belle Hill, of the Pittsburg office.

The intention here is to refer only to those experts who have continued for a greater or less period with the reports to the present time, and these include also such valued contributors as Dr. Heinrich Ries, Dr. Edmund Otis Hovey, Dr. F. J. H. Merrill, and others. It is the monumental work of these coworkers in building and, what is more difficult. in maintaining this series which is here acknowledged with great appreciation from the Survey, with much personal gratitude from the compiler in charge, and with sincere regret at the breaking of the ties of a score of years of joint endeavor. The labor of taking up this work among the staff of capable economic geologists in the Survey involves formidable difficulty. But just as the coal statistics begun by Messrs. Saward, Ashburner, Jones, and Ruley have been successfully developed in the Survey by Mr. E. W. Parker, so we may expect success for the other subjects, especially since the same loyalty with which our former contributors have withstood the irksomeness of repeated effort can still be safely counted upon, now that the responsibility is removed and is substituted by the pleasure of lending a helping hand to the other man.

NOTES.

Statistics of the production of glass sand and sand for molding, building, engine, and furnace use, and for other purposes, include the production of gravel for the first time in 1905.

Included in the volume for 1905 is a brief report calling attention to peat in the United States and to its great possibilities as a source of fuel, especially in such States as Florida, Maine, Massachusetts, Minnesota, and Wisconsin, which have little or no coal within their boundaries, but have large deposits of peat that are easily accessible to the commercial centers.

Metallic tin was not produced in the United States in 1905, and the output of tin ore was insignificant.

The slate industry has been given a chapter to itself, independent of stone.

Lime also has been separated from the stone report, and the production of lime and of sand-lime brick is published in a separate chapter.

The production of carbon dioxide, especially at Saratoga Springs, New York, is discussed in this volume for the first time in this series of reports.

In addition to the reports on metallic zinc and lead, a chapter is given on zinc and lead ores.

The chapter on black sands gives the results thus far obtained of the investigations that have been in progress for more than a year at Portland, Oreg., and that will be continued at the Jamestown Exposition in Virginia during the spring and summer of 1907.

For the first time the statistics of the production and consumption of water gas in this country are given in the chapter on manufactured gas, gas coke, coal tar, and ammonia.

SUMMARY OF THE MINERAL PRODUCTION OF THE UNITED STATES IN 1905.

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 almost 9 per cent less than that for 1903.

In 1905, for the seventh time, the total value of our mineral production exceeded the enormous sum of $1,000,000,000.

The exact figures for 1905 are $1,623,877,120, as compared with $1,360,883,554 in 1904, with $1,491,885,341 in 1903, with $1,323,068,677 in 1902, with $1,141,972,309 in 1901, with $1,107,020,352 in 1900, and with $1,014,355,705 in 1899; a gain in 1905 over 1904 of $262,993,566, or 19.33 per cent; a gain in 1905 over 1903 of $131,991,779, or 8.85 per cent; over 1902 of $300,808,443, or 22.74 per cent; over 1901 of $481,904,811, or 42.20 per cent; over 1900 of $516,856,768, or 46.69 per cent, and a gain in 1905 over 1899 of $609,521,415, or 60.09 per cent.

As heretofore, iron and coal are the most important of our mineral products. The value of the iron in 1905 was $382,450,000; the value of the coal, $476,756,963. The fuels increased from $584,043,236 in 1904 to $602,477,217 in 1905, a gain of $18,433,981, or 3.16 per cent. Anthracite coal showed an increase in value of $2,904,980—from $138,974,020 in 1904 to $141,879,000 in 1905. The average price of anthracite coal per long ton at the mine was $2.25, as against $2.35 in 1904, $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 $1.06, as against $1.10 in 1904, $1.24 in 1903, and $1.12 in 1902. The increase in value of the bituminous coal output over 1904 was $29,480,962, a combined increase in value of coal of $32,385,942 in 1905, or 7.3 per cent.

The gain of $262,993,566 in the total value of our mineral production is due to gains in both metallic and nonmetallic products, the metallic products showing an increase from $501,099,950 in 1904 to $702,453,101 in 1905, a gain of $201,353,151, and the nonmetallic products showing an increase from $859,383,604 in 1904 to $921,024,019 in 1905, a gain of $61,640,415. To these products should be added estimated unspecified products, including molybdenum, bismuth, tungsten, and other mineral products, valued at $400,000, making the total mineral production for 1905 of $1,623,877,120.

METALS.

Iron and steel.—Twenty States produced pig iron in 1905, as against 20 in 1904, 22 in 1903, 22 in 1902, 20 in 1901, and 21 in 1900 and in 1899. The total production of pig iron in 1905 was 22,992,380 long tons, as against 16,497,033 long tons in 1904, 18,009,252 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 1905 shows an increase in quantity of 6,495,347 long tons, or over 39 per cent, over the production of 1904 and an increase in value from $233,025,000 to $382,450,000, amounting to $149,425,000, or 64.12 per cent. The average price per long ton of pig iron increased from $14.13 in 1904 to $16.63 in 1905. The average prices per long ton in recent years have been as follows: 1903, $19.12; 1902, $20.92; 1901, $15.25; 1900, $18.85; 1899, $18; 1897, $9.85; 1896, $10.47.

Iron ores.—The production of iron ores in 1905 amounted to 42,526,133 long tons, as compared with 27,644,330 long tons in 1904, with 35,019,308 long tons in 1903, and with 35,554,135 long tons in 1902, a gain in 1905 over 1904 of 14,881,803 long tons, or about 54 per cent. The value at the mines of the ore mined in 1905 was $75,165,604, a gain as compared with the 1904 value, $43,186,741, of $31,978,863, or 74 per cent. As in the six preceding years, the production of iron ores in the United States in 1905 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 to 3,146 long tons, valued at $29,466, in 1904, and to 4,118 long tons, valued at $36,214, in 1905. The average price per ton in 1905 was $8.80, as compared with $9.37 in 1904, with $8.97 in 1903, with $8.15 in 1902, and with $9.73 in 1901.

Gold.—The production of gold increased from 3,910,729 ounces, valued at $80,835,648, in 1904, to 4,265,742 ounces, valued at $88,180,700, in 1905, an increase of 355,013 ounces in quantity and of $7,345,052 in value.

Silver.—The production of silver increased in quantity from 55,999,864 ounces in 1904 to 56,101,600 ounces in 1905, a gain of 101,736 ounces; but it increased in commercial value from $32,035,378 in 1904 to $34,221,976 in 1905, a gain of $2,186,598.

Copper.—The production of copper increased from 812,537,267 pounds, valued at $105,629,845, in 1904, to 901,907,843 pounds, valued at $139,795,716, in 1905, an increase of $89,370,576 pounds in quantity and of $34,165,871 in value.

Lead.—The production of lead in 1905 was 302,000 short tons, as against 307,000 short tons in 1904 and 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 1905 was $28,690,000, as compared with $26,402,000 in 1904, 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 1905 showed an increase in quantity as compared with 1904, 1903, 1902, and 1901, the production being 203,849 short tons, as compared with 186,702 short tons in 1904, 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 1905 was $24,054,182, as compared with $18,670,200 in 1904, 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.

Bauxite.—In 1905 the production of bauxite was 48,129 long tons, valued at $240,292, as compared with 47,661 long tons, valued at $235,704, in 1904; 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.

Aluminum.—The consumption of aluminum during 1905 was 11,347,000 pounds, valued at $3,246,300, as compared with 8,600,000 pounds, valued at $2,477,000 in 1904.

Quicksilver.—The production of quicksilver during 1905 amounted to 30,451 flasks (of 76½ avoirdupois pounds net; 75 avoirdupois pounds net after June, 1904), as compared with 34,570 flasks in 1904, 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 1905 was $1,103,120, as compared with $1,503,795 in 1904, 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 reported 24,635 flasks, as compared with 29,217 flasks in 1904, with 30,526 flasks in 1903, with 28,972 flasks in 1902, and with 26,720 flasks in 1901; and Texas reported 4,723 flasks, as against 5,336 flasks in 1904, 5,029 flasks in 1903, 5,319 flasks in 1902, and 2,932 flasks in 1901. Utah reported 1,050 flasks in 1905.

Chromic iron ore.—California was the only State producing chromite during 1905, the quantity being 25 long tons, valued at $375, as compared with 123 long tons, valued at $1,845, in 1904; 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.

Molybdenum.—The commercial production of molybdenum in 1905 was in excess of the 1904 production, which was 14.5 short tons of concentrates, valued at $2,175. The production in 1903 was 795 short tons of concentrates, valued at $60,865. The value of molybdenum ores fluctuates very greatly.

Nickel.—There was no production of metallic nickel reported in 1905, only a small quantity of nickel and cobalt ore being reported as sold. In 1904 the output 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, and of 9,715 pounds in 1900. The value in 1904 was $11,400, as against $45,900 in 1903, $2,701 in 1902, $3,551 in 1901, and $3,886 in 1900. The imports of nickel in 1905 were valued at $1,962,131, as against $1,121,491 in 1904, $1,493,889 in 1903, $1,437,649 in 1902, $1,849,620 in 1901, and $1,183,884 in 1900.

Rutile.—A small production of rutile was reported in 1905.

Tungsten.—The commercial production of concentrated tungsten ores during 1905 amounted approximately to 803 short tons, valued at $268,676, as against 740 short tons, valued at $184,000, in 1904; 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 1905, as reported to the Survey, was valued at $375, as against $10,600 in 1904, $5,625 in 1903, and $48,125 in 1902.

Platinum.—The production of platinum from domestic ores in 1905 was 318 ounces, valued at $5,320, as compared with 200 ounces, valued at $4,160 in 1904; with 110 ounces, valued at $2,080 in 1903; with 94 ounces, valued at $1,814 in 1902; with 1,408 ounces, valued at $27,526 in 1901, and with 400 ounces, valued at $2,500 in 1900. In December, 1904, the price of ingot platinum at New York advanced from $18.50 to $19.50 per ounce; in April, 1905, it was $20.50; in February, 1906, it advanced to $25, and in September, 1906, it was $34 per ounce.

Antimony.—The total quantity of antimony obtained from all sources in 1905 was 3,240 short tons, as against 3,057 short tons in 1904, and 3,128 short tons in 1903. No antimony was obtained from domestic ores during 1905. The antimony obtained from the smelting of foreign imported ores in 1905 amounted to 493 short tons, valued at $117,433, and the antimony obtained from hard lead produced from foreign and domestic lead ores was 2,747 short tons, valued at $588,354, a total production for 1905 of 3,240 short tons, valued at $705,787, as compared with 3,057 short tons, valued at $505,524 in 1904; 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 1905 was 24,405 pounds, valued at $4,187; in 1904 it was 5,184 pounds, valued at $314. There was no marketed production of bismuth ores in the United States during 1903 or 1902. Interesting features in the bismuth industry in 1905 were the shipment of ore from a new deposit in California, the resumption of mining on the Ballard property in Colorado, and the reduction of 50 per cent in the price of the metal in London from 10s. ($2.43) to 5s. ($1.22) per pound.

Tin.—There was no production of metalic tin in 1905, and only a small output of ore from the placers of Buck Creek, Alaska.

FUELS.

Coal.—For the fourth time in the history of the United States the production of coal in 1905 reached a total of over 300,000,000 short tons, showing an actual output of 392,919,341 tons of 2,000 pounds, valued at $476,756,963. Of this total, the output of anthracite coal amounted to 69,339,152 long tons (equivalent to 77,659,850 short tons), which, as compared with the production of 65,318,490 long tons in 1904, was an increase of 4,020,662 long tons, or 6 per cent. The value of anthracite coal at the mines in 1905 was $141,879,000, as against $138,974,020 in 1904, $152,036,448 in 1903, $76,173,586 in 1902, and $112,504,020 in 1901. The average value of the marketed anthracite coal sold during the year at the mines was $2.25, as against $2.35 per long ton in 1904, 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 1905 to 315,259,491 short tons, valued at $334,877,963, as compared with 278,659,689 short tons, valued at $305,397,001, in 1904; 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 increase in the production of bituminous coal in 1905 over 1904 was therefore 36,599,802 short tons in quantity and $29,480,962 in value. The average price of bituminous coal per ton at the mines during 1905 was $1.06, as against $1.10 in 1904 and $1.24 per ton in 1903, the highest price recorded by the Survey.

Coke.—The coke production of the United States in 1905, which included the output from 3,159 retort or by-product ovens, amounted to 32,231,129 short tons, as compared with 23,661,106 short tons in 1904, 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 increase in quantity in 1905 from 1904 was 8,570,023 short tons, or 36.22 per cent. The total value was $72,476,196, as against $46,144,941 in 1904, a gain of $26,331,255, or 57 per cent. The average price per ton in 1905 was $2.25, against $1.95 in 1904. The average output from the by-product ovens in 1905 was 1,158.8 tons per oven, against an average of 365.8 tons per oven from the beehive ovens.

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 1905 was $56,684,972, as against $51,157,736 in 1904 and $47,830,600 in 1903.

Natural gas.—The value of the natural gas produced in 1905 was $41,562,855, as compared with $38,496,760 in 1904, with $35,807,860 in 1903, with $30,867,863 in 1902, with $27,066,077 in 1901, and with $23,698,674 in 1900—a gain of about 8 per cent in 1905 over 1904.

Petroleum.—The total production of crude petroleum in the United States in 1905 was 134,717,580 barrels, as against 117,080,960 barrels in 1904, 100,461,337 barrels in 1903, 88,766,916 barrels in 1902, and 69,389,194 barrels in 1901, an increase of 17,636,620 barrels or 15 per cent over the production of 1904, and of about 34 per cent over that of 1903. The increase in 1904 came from Kansas and Indian Territory and Oklahoma, Louisiana, Texas, California, Kentucky and Tennessee, and Illinois, in the order named. In round numbers, the gains in 1905 over 1904 were as follows: Kansas and Indian Territory and Oklahoma, 6,395,000 barrels; Louisiana, 5,950,000 barrels; Texas, 5,890,000 barrels; Kentucky and Tennessee, 219,000 barrels; and Illinois, 181,000 barrels. The largest decreases in production in 1905, as compared with 1904, were in Ohio, which showed a decrease of about 2,529,000 barrels; West Virginia, 1,066,000 barrels; Pennsylvania, 688,000 barrels; Indiana, 374,000 barrels; and Colorado, 125,000 barrels. It will be observed that the greatest gains were in the South and West, and that, relatively, the Appalachian field lost heavily. The value of crude petroleum produced during 1905 was $84,157,399, or an average price of 62.47 cents per barrel, as against $101,175,455, or 86.41 cents per barrel, in 1904, as against $94,694,050, or 94.26 cents per barrel, in 1903, and against $71,178,910, or 80.19 cents per barrel, in 1902.

STRUCTURAL MATERIALS.

Cement.—The total production of hydraulic cement in the United States in 1905 was 40,102,308 barrels, valued at $35,931,533, as compared with 31,675,257 barrels, valued at $26,031,920, in 1904; 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 1905 was 35,246,812 barrels, valued at $33,245,867, as compared with 26,505,881 barrels, valued at $23,355,119, in 1904; 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 1905 as compared with 1904 of 8,740,931 barrels and in value of $9,890,748. The production of natural rock cement in 1905 was 4,473,049 barrels, valued at $2,413,052, as compared with 4,866,331 barrels, valued at $2,450,150, in 1904; 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 1905 of 393,282 barrels and in value of $37,098. The production of slag cement in 1905 amounted to 382,447 barrels, valued at $272,614, as against 303,045 barrels, valued at $226,651, in 1904, and 525,896 barrels, valued at $542,502, in 1903.

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, but increased vigorously in 1905. The value of all clay products, as reported to this office in 1905, was $149,697,188, as against $131,023,248 in 1904, $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 1905 were valued at $121,778,294, as against $105,864,978 in 1904, $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 1905 at $27,918,894, as against $25,158,270 in 1904, $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 in 1905 by those not manufacturing the clay themselves was valued at $2,768,006, as against $2,320,162 in 1904, $2,594,042 in 1903, $2,061,072 in 1902, $2,576,932 in 1901, and $1,840,377 in 1900.

Lime.—The production of lime in 1905 was 2,984,100 short tons, valued at $10,941,680, as against 2,707,809 short tons, valued at $9,951,456, in 1904. The output was valued at $9,255,882 in 1903, at $9,335,618 in 1902, and at $8,204,054 in 1901.

Sand-lime brick.—The production of sand-lime brick in 1905 was valued at $972,064, as against $463,128 in 1904, and $155,040 in 1903.

Slate.—The production of slate in 1905 was valued at $5,496,207, as against $5,617,195 in 1904, $6,256,885 in 1903, $5,696,051 in 1902, and $4,787,525 in 1901.

Stone.—The value of all kinds of stone produced in the United States during 1905 amounted to $63,798,748, as compared with $58,765,715 in 1904, with $57,433,141 in 1903, with $54,798,682 in 1902, with $47,284,183 in 1901, and with $36,970,777 in 1900.

Included under stone is the limestone used for fluxing in blast furnaces, which in 1905 was 15,387,891 long tons, valued at $7,004,265, as compared with 10,657,038 long tons, valued at $4,702,768, in 1904, 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.

ABRASIVE MATERIALS

Alundum or artificial corundum.—The production of alundum by the Norton Emery Wheel Company amounted in 1905 to 3,612,000 pounds, valued at $252,840, an average of 7 cents per pound, as compared with 4,020,000 pounds manufactured in 1904.

Carborundum.—The production of carborundum in 1905 was 5,596,000 pounds, as against 7,060,380 pounds in 1904, 4,759,890 pounds in 1903, 3,741,500 pounds in 1902, and 3,838,175 pounds in 1901. The value of the carborundum varies from 7 to 10 cents a pound.

Corundum and emery.—The combined production of corundum and emery in 1905 amounted to 2,126 short tons, valued at $61,464, as against 1,916 short tons, valued at $56,985, in 1904; 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 1905 was 612,000 pounds, as against 790,000 pounds in 1904, 755,000 pounds in 1903, 735,000 pounds in 1902, and 690,000 pounds in 1901.

Crystalline quartz.—In 1905 the production of crystalline quartz included under abrasives amounted to 19,039 short tons, valued at $88,118, as against 31,940 short tons, valued at $74,850, in 1904; 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 1905 amounted to 5,050 short tons, valued at $148,095, as against 3,854 short tons, valued at $117,581, in 1904; 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 1905 production is reported as $29.32 per ton.

Grindstones.—The total value of all kinds of grindstones produced during 1905 was $777,606, as against $881,527 in 1904, $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 ranged 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 price per ton reported for the 1905 product varied from $6.67 to $16.50.

Infusorial earth and tripoli.—In 1905 the production of infusorial earth and tripoli amounted to 10,977 short tons, valued at $64,637, as against 6,274 short tons, valued at $44,164, in 1904; 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 1905 was $37,974, as against $37,338 in 1904, $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 comparative decrease in 1903, 1904, and 1905.

Oilstones and whetstones.—There was a decided increase in the commercial domestic production of oilstones and whetstones during 1905, the value rising from $188,985 in 1904 to $244,546 in 1905. The production was valued at $366,857 in 1903, at $221,762 in 1902, and at $158,300 in 1901.

Pumice.—The production of pumice amounted in 1905 to 1,832 short tons, valued at $5,540, as against 1,530 short tons, valued at $5,421 in 1904; 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 1905 was 1,507,386 pounds, valued at $35,210, as against 72,413 pounds, valued at $2,185, in 1904; 1,222,000 pounds, valued at $36,691, in 1903; 2,706,000 pounds, valued at $81,180, in 1902, and 600,000 pounds, valued at $18,000, in 1901.

Borax.—The reported returns for 1905 gave an aggregate production of crude borax of 46,334 short tons, valued at $1,019,154, as against 45,647 short tons, valued at $698,810, in 1904, and 34,430 short tons, valued at $661,400 in 1903.

Bromine.—The production of bromine in 1905, including the bromine contained in potassium bromide, amounted to 1,192,758 pounds, valued at $178,914, as compared with 897,100 pounds, valued at $269,130 in 1904; 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 1905 was 57,385 short tons, valued at $362,488, as compared with 36,452 short tons, valued at $234,755, in 1904; 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—an increase in 1905 in quantity of 20,933 short tons and in value of $127,733 over 1904. The prices of crude fluorspar in 1905 were reported as ranging from $4 to $8 per ton and the prices of ground fluorspar as ranging from $10 to $12 per ton.

Gypsum.—The output of crude gypsum in 1905 was 1,043,202 short tons, valued in its first marketable condition at $3,029,227, as compared with 940,917 short tons, valued at $2,784,325, in 1904; with 1,041,704 short tons, valued 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 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.

Lithium minerals.—The production of lithium minerals in 1905 was 21 short tons, valued at $252, as against 577 short tons, valued at $5,155, in 1904, and 1,155 short tons, valued at $23,425, in 1903. The output in 1905 was all from San Diego County, California.

Marls.—The production of marls in the United States in 1905 was 38,026 short tons, valued at $16,494; in 1904 it 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 1905 amounted to 1,947,190 long tons, valued at $6,763,403, as compared with 1,874,428 long tons, valued at $6,580,875, in 1904; 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 1905 over 1904 of 72,762 long tons, and in value of $182,528. The total quantity of phosphate rock reported as mined during 1905 was 2,138,309 long tons, as against 1,991,169 long tons mined in 1904; 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 1905 amounted to 25,966,122 barrels of 280 pounds, valued at $6,095,922, as compared with 22,030,002 barrels, valued at $6,021,222, in 1904; 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 domestic production of sulphur in 1905 was 181,677 long tons, valued at $3,706,560; the production of pyrite was 253,000 long tons, valued at $938,492. The combined production in 1904 of sulphur and pyrite for the manufacture of sulphuric acid amounted to 334,373 long tons, valued at $3,478,568, 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 1905 was 48,235 short tons, valued at $148,803, as compared with 65,727 short tons, valued at $174,958, in 1904; 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.—There was no production of cobalt oxide reported in 1905; in 1904 it 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, Missouri.

Mineral paints.—The commercial production of mineral paints in 1905 amounted to 56,599 short tons, valued at $724,933, as compared with 52,336 short tons, valued at $493,434, in 1904; with 56,262 short tons, valued at $500,922, in 1903; with 60,191 short tons, valued at $745,227, in 1902; and with 52,209 short tons, valued at $636,145, in 1901.

Zinc white.—The production of zinc white in 1905 amounted to 68,603 short tons, valued at $5,520,240, as compared with 63,363 short tons, valued at $4,808,482, in 1904; 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 1905 was obtained chiefly from deposits in Georgia, Virginia, and Massachusetts, with small quantities from Arizona, California, Michigan, and Wyoming. The total commercial production was 3,109 short tons, valued at $42,975, as against 1,480 short tons, valued at $25,740, in 1904; 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 elsewhere under the heading "Petroleum." The commercial production in 1905 was 115,267 short tons, valued at $758,153, as against 108,572 short tons, valued at $879,836, in 1904; 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.

Feldspar.—The production of feldspar in 1905 was 35,419 short tons, valued at $226,157, as against 45,188 short tons, valued at $266,326, in 1904; 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—a decrease in 1905 from 1904 of 9,769 tons in quantity and of $40,169 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 1905 the production was 56,500 short tons, valued at $445,000, as against 64,005 short tons, valued at $507,400, in 1904; 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.

Fuller's earth.—As reported to the Survey, the production of fuller's earth in 1905 was 25,178 short tons, valued at $214,497, as compared with 29,480 short tons, valued at $168,500, in 1904; 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. The imports in 1905 were valued at $105,997, as against $74,006 in 1904.

Glass sand.—The production of glass sand in 1905 was 1,030,334 short tons, valued at $1,083,730, as against 858,719 short tons, valued at $796,492, in 1904; 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 1905 amounted to 6,036,567 pounds, valued at $237,572, as compared with 5,681,177 pounds, valued at $238,447, in 1904; with 4,538,155 pounds, valued at $154,170, in 1903; with 3,936,824 pounds, valued at $126,144, in 1902, and with 3,967,612 pounds, valued at $135,914, in 1901. The production of amorphous graphite in 1905 was 21,953 short tons, valued at $80,639, as compared with 16,927 short tons, valued at $82,925, in 1904; with 16,591 short tons, valued at $71,384, in 1903; with 4,739 short tons, valued at $55,964, in 1902, and with 809 short tons, valued at $31,800, in 1901. The production of artificial graphite in 1905 was 4,591,550 pounds, valued at $313,980, the average price being 6.38 cents per pound, as compared with 3,248,000 pounds, valued at $217,790, the average price being 6.71 cents per pound, in 1904; 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 4.69 cents per pound.

Magnesite.—The production of magnesite in the United States continues to be limited to California. During the year 1905 the commercial production reported was 3,933 short tons, valued at $15,221, as compared with 2,850 short tons, valued at $9,298, in 1904; 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 1905 was 851,800 pounds of sheet mica, valued at $185,900, and 856 short tons of scrap mica, valued at $15,255, as against 668,358 pounds of sheet mica, valued at $109,462, and 1,096 short tons of scrap mica, valued at $10,854, in 1904, and against a total value of $143,128 in 1903 and a total value of $118,849 in 1902.

Mineral waters.—The total production of mineral waters in 1905 was 47,590,081 gallons, valued at $6,811,611, as compared with 50,723,500 gallons, valued at $7,198,450, in 1904; 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.

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 1905 the production (including small quantities of zircon and columbite) amounted to 1,352,418 pounds, valued at $163,908, as compared with 745,999 pounds (including small quantities of zircon, columbite, and gadolinite), valued at $85,038, in 1904; 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—an increase in 1905 of 606,419 pounds in quantity and of $78,870 in value, as compared with 1904.

Peat.—There was no commercial production of peat in 1905. Considerable experimental work has been done in the production of peat bricks for use as fuel under boilers, and in the practical tests of machine peat (that is, disintegrated peat molded into bricks without pressure and dried without artificial heat) as a producer-gas fuel at the coal-testing plant of the United States Geological Survey at St. Louis, Mo.

Potassium salts.—There was no production of potassium salts in the United States in 1905; the imports amounted to 300,446,588 pounds, valued at $5,346,230.

Precious stones.—The value of the gems and precious stones found in the United States in 1905 was $326,350, as against $324,300 in 1904, $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.

Quartz (flint).—The production of flint in 1905 was 51,145 short tons, valued at $104,109, as against 52,270 short tons, valued at $100,590, in 1904; 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.

Sand and gravel.—The production of sand for molding, building, engine, furnace, and other purposes, and of gravel, reported in 1905 was 22,144,633 short tons, valued at $10,115,915, as against 9,821,009 short tons, valued at $4,951,607, in 1904.

Talc and soapstone.—Exclusive of the production of fibrous talc from Gouverneur, N. Y., the production of talc and soapstone in 1905 amounted to 40,134 short tons, valued at $637,062, as compared with 27,184 short tons, valued at $433,331, in 1904; with 26,671 short tons, valued at $418,460, in 1903; with 26,854 short tons, valued at $525,157, in 1902, and with 28,643 short tons, valued at $424,888, in 1901.

MINERAL PRODUCTS OF THE UNITED STATES IN 1904 AND 1905.

The two following tables should be sharply discriminated. From the tabular statement headed "Mineral products of the United States in 1904 and 1905" all unnecessary duplication has been excluded. The manufactured coke product, amounting to 32,231,129 short tons and valued at $72,476,196, is excluded, as the quantity and value of the coal used in its manufacture are 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 largely 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, on the other hand, 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 iron ores being excluded. Similarly, the value of the products of the clay industries is given as being the first marketable condition of the greater part of the clay produced, although the production and value of the clay mined and sold in the raw state by clay miners to manufacturers of clay are elsewhere shown separately, but are not included in the tabular statement in order to avoid duplication.

In the second large table, however, which gives the "Value, by States, of mineral products of the United States in the calendar year 1905," raw clay, iron ores, lead paints, and the coal products are included under the respective producing States.

It will be seen that the two tables differ materially. They both give the value of the mineral products in the year 1905; but the first gives the net value of the mineral products of the whole country in their first marketable form and the second gives the value of these products and, in addition, the value of some of their raw materials or derivatives in their first marketable condition. The first table avoids duplication; the second does not.

The figures for gold and silver for 1905 in the first table are the figures agreed upon by the United States Geological Survey and the Director of the Mint.

Mineral products of the United

	Product.	1904.	
		Quantity.	Value.
	METALLIC.		
1	Pig iron (spot value) ... long tons..	16,497,033	$233,025,000
2	Silver, commercial value ... troy ounces..	55,999,864	32,035,378
3	Gold, coining value ... do....	3,910,729	80,835,648
4	Copper, value at New York City ... pounds..	812,537,267	105,629,845
5	Lead, value at New York City ... short tons..	307,000	26,402,000
6	Zinc, value at New York City ... do....	186,702	18,670,200
7	Quicksilver, value at San Francisco ... flasks..	34,570	1,503,795
8	Aluminum, value at Pittsburg ... pounds..	8,600,000	2,477,000
9	Antimony, value at San Francisco ... short tons..	3,057	505,524
10	Nickel, value at Philadelphia ... pounds..	24,000	11,400
11	Tin ... do....	...	...
12	Platinum, value (crude) at New York City ... troy ounces..	200	4,160
13	Total value of metallic products ...	...	501,099,950
	NONMETALLIC (SPOT VALUES).		
14	Bituminous coal ... short tons..	278,659,689	305,397,001
15	Pennsylvania anthracite ... long tons..	65,318,490	138,974,020
16	Natural gas ...	...	38,496,760
17	Petroleum ... barrels..	117,080,960	101,175,455
18	Clay products ...	...	131,023,248
19	Cement ... barrels..	31,675,257	26,031,920
20	Lime ... short tons..	2,707,809	9,951,456
21	Sand-lime brick ...	...	463,128
22	Slate ...	...	5,617,195
23	Stone ...	...	58,765,715
24	Corundum and emery ... short tons..	1,916	56,985
25	Crystalline quartz ... do....	31,940	74,850
26	Garnet for abrasive purposes ... do....	3,854	117,581
27	Grindstones ...	...	881,527
28	Infusorial earth and tripoli ... short tons..	6,274	44,164
29	Millstones ...	...	37,338
30	Oilstones, etc ...	...	188,985
31	Arsenious oxide ... pounds..	72,413	2,185
32	Borax (crude) ... short tons..	45,647	698,810
33	Bromine ... pounds..	897,100	269,130
34	Fluorspar ... short tons..	36,452	234,755
35	Gypsum ... do....	940,917	2,784,325
36	Lithium minerals ... do....	577	5,155
37	Marls ... do....	18,989	13,145
38	Phosphate rock ... long tons..	1,874,428	6,580,875
39	Pyrite ... do....	334,373	3,478,568
40	Sulphur ... do....		
41	Salt ... barrels..	22,030,002	6,021,222
42	Barytes (crude) ... short tons..	65,727	174,958
43	Cobalt oxide ... pounds..	22,000	42,600
44	Mineral paints ... short tons..	52,336	493,434
45	Zinc white ... do....	63,363	4,808,482
46	Asbestos ... do....	1,480	25,740
47	Asphaltum ... do....	108,572	879,836
48	Bauxite ... long tons..	47,661	235,704
49	Chromic iron ore ... do....	123	1,845
50	Feldspar ... short tons..	45,188	266,326

States in 1904 and 1905.

1905.		Increase (+) or decrease (−) in 1905.		Per cent of increase (+) or decrease (−) in 1905.		
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
22,992,380	$382,450,000	+ 6,495,347	+$149,425,000	+ 39.37	+ 64.12	1
56,101,600	34,221,976	+ 101,736	+ 2,186,598	+ .90	+ 6.83	2
4,265,742	88,180,700	+ 355,013	+ 7,345,052	+ 9.08	+ 9.09	3
901,907,843	139,795,716	+89,370,576	+ 34,165,871	+ 11.00	+ 32.34	4
302,000	28,690,000	− 5,000	+ 2,288,000	− 1.63	+ 86.66	5
203,849	24,054,182	+ 17,147	+ 5,383,982	+ 9.18	+ 20.88	6
30,451	1,103,120	− 4,119	− 400,675	− 11.91	− 26.64	7
11,347,000	3,246,300	+ 2,747,000	+ 769,300	+ 31.94	+ 31.06	8
3,240	705,787	+ 183	+ 200,263	+ 5.99	+ 39.61	9
....	....	− 24,000	− 11,400	− 100.00	− 100.00	10
....	....	....	....	....	....	11
318	5,320	+ 118	+ 1,160	+ 59.00	+ 27.88	12
....	702,453,101	....	+ 201,353,151	....	+ 40.18	13
315,259,491	334,877,963	+36,599,802	+ 29,480,962	+ 13.13	+ 9.65	14
69,339,152	141,879,000	+ 4,020,662	+ 2,904,980	+ 6.16	+ 2.09	15
....	41,562,855	....	+ 3,066,095	....	+ 7.96	16
134,717,580	84,157,399	+17,636,620	− 17,018,056	+ 15.06	− 16.82	17
....	149,697,188	....	+ 18,673,940	....	+ 14.25	18
40,102,308	35,931,533	+ 8,427,051	+ 9,899,613	+ 26.60	+ 38.03	19
2,984,100	10,941,680	+ 276,291	+ 990,224	+ 10.20	+ 9.95	20
....	972,064	....	+ 508,936	....	+ 109.89	21
....	5,496,207	....	− 120,988	....	− 2.15	22
....	63,798,748	....	+ 5,033,033	....	+ 8.56	23
2,126	61,464	+ 210	+ 4,479	+ 10.96	+ 7.86	24
19,039	88,118	− 12,901	+ 13,268	− 40.39	+ 17.73	25
5,050	148,095	+ 1,196	+ 30,514	+ 31.03	+ 25.95	26
....	777,606	....	− 103,921	....	− 11.79	27
10,977	64,637	+ 4,703	+ 20,473	+ 74.96	+ 46.36	28
....	37,974	....	+ 636	....	+ 1.70	29
....	244,546	....	+ 55,561	....	+ 29.40	30
1,507,386	35,210	+ 1,434,973	+ 33,025	+1,981.65	+1,511.44	31
46,334	1,019,154	+ 687	+ 320,344	+ 1.51	+ 45.84	32
1,192,758	178,914	+ 295,658	− 90,216	+ 32.96	− 33.52	33
57,385	362,488	+ 20,933	+ 127,733	+ 57.43	+ 54.41	34
1,043,202	3,029,227	+ 102,285	+ 244,902	+ 10.87	+ 8.80	35
21	252	− 556	− 4,903	− 963.60	− 951.12	36
38,026	16,494	+ 19,037	+ 3,349	+ 100.25	+ 25.48	37
1,947,190	6,763,403	+ 72,762	+ 182,528	+ 3.88	+ 2.77	38
253,000	938,492	+ 100,304	+ 1,166,484	+ 30.00	+ 33.53	39
181,677	3,706,560					40
25,966,122	6,095,922	+ 3,936,120	+ 74,700	+ 17.87	+ 1.24	41
48,235	148,803	− 17,492	− 26,155	− 26.61	− 14.95	42
....	....	− 22,000	− 42,600	− 100.00	− 100.00	43
56,599	724,933	+ 4,263	+ 231,499	+ 8.15	+ 46.92	44
68,603	5,520,240	+ 5,240	+ 711,758	+ 8.27	+ 14.80	45
3,109	42,975	+ 1,629	+ 17,235	+ 110.07	+ 66.96	46
115,267	758,153	+ 6,695	− 121,683	+ 6.17	− 13.83	47
48,129	240,292	+ 468	+ 4,588	+ .98	+ 1.95	48
25	375	− 98	− 1,470	− 79.67	− 79.67	49
35,419	226,157	− 9,769	− 40,169	− 21.62	− 15.08	50

Mineral products of the United

	Product.	1904. Quantity.	1904. Value.
	NONMETALLIC (SPOT VALUES)—continued.		
51	Fibrous talc .... short tons..	64,005	$507,400
52	Fuller's earth .... do....	29,480	168,500
53	Glass sand .... do....	858,719	796,492
54	Graphite: Crystalline .... pounds..	5,681,177	321,372
	Graphite: Amorphous .... short tons..	16,927	
55	Magnesite .... do....	2,850	9,298
56	Manganese ore .... long tons..	3,146	29,466
57	Mica: Sheet .... pounds..	668,358	109,462
	Mica: Scrap .... short tons..	1,096	10,854
58	Mineral waters .... gallons sold..	50,723,500	7,198,450
59	Monazite and zircon .... pounds..	745,999	85,038
60	Precious stones	....	324,300
61	Pumice stone .... short tons..	1,530	5,421
62	Quartz (flint) .... do....	52,270	100,590
63	Rutile	....	7,000
64	Sand, molding, building, etc., and gravel .... short tons..	9,821,009	4,951,607
65	Talc and soapstone .... do....	27,184	433,331
66	Uranium and vanadium .... do....	45	10,600
67	Total value of nonmetallic mineral products	....	859,383,604
68	Total value of metallic products	....	501,099,950
69	Estimated value of mineral products unspecified	....	400,000
70	Grand total	....	1,360,883,554

States in 1904 and 1905—Continued.

1905.		Increase (+) or decrease (−) in 1905.		Per cent of increase (+) or decrease (−) in 1905.		
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
56,500	$445,000	− 7,505	− $62,400	− 11.73	− 12.30	51
25,178	214,497	− 4,302	+ 45,997	− 14.59	+ 27.35	52
1,030,334	1,083,730	+ 171,615	+ 287,238	+ 19.99	+ 36.06	53
6,036,567	318,211	+ 355,390	− 3,161	+ 6.26	− .98	54
21,953		+ 5,026		+ 29.69		
3,933	15,221	+ 1,083	+ 5,923	+ 38.00	+ 63.70	55
4,118	36,214	+ 972	+ 6,748	+ 30.90	+ 22.90	56
851,800	185,900	+ 183,442	+ 76,438	+ 27.45	+ 69.83	57
856	15,255	− 240	+ 4,401	− 21.90	+ 40.55	
47,590,081	6,811,611	− 3,133,419	− 386,839	− 6.18	− 5.37	58
1,352,418	163,908	+ 606,419	+ 78,870	+ 81.29	+ 92.75	59
....	326,350	....	+ 2,050	....	+ .63	60
1,832	5,540	+ 302	+ 119	+ 19.74	+ 2.20	61
51,145	104,109	− 1,125	+ 3,519	− 2.15	+ 3.50	62
....	....	....	− 7,000	....	−100.00	63
22,144,633	10,115,915	+12,323,624	+ 5,164,308	+125.48	+104.30	64
40,134	637,062	+ 12,950	+ 203,731	+ 47.64	+ 47.02	65
4	375	− 41	− 10,225	− 91.11	− 96.46	66
....	921,024,019	....	+ 61,640,415	....	+ 7.17	67
....	702,453,101	....	+201,353,151	....	+ 40.18	68
....	400,000	....	....	....	....	69
....	1,623.877,120	....	+262,993,566	....	+ 19.33	70

Mineral products of the United States

	Product.	1880. Quantity.	Value.
	METALLIC.		
1	Pig iron, value at Philadelphia .... long tons..	3,375,912	$89,315,569
2	Silver, commercial value .... troy ounces..	30,318,700	34,717,000
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	....	185,649,163
	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	....	185,649,163
57	Estimated value of mineral products unspecified	....	6,000,000
58	Grand total	....	364,928,298

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

for the calendar years 1880–1905.

1881.		1882.		1883.		
Quantity,	Value.	Quantity.	Value.	Quantity.	Value.	
4,141,254	$87,029,334	4,623,323	$106,336,429	4,595,510	$91,910,200	1
33,257,800	37,657,500	36,196,900	41,105,900	35,732,800	39,618,400	2
1,678,612	34,700,000	1,572,187	32,500,000	1,451,250	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
....	187,549,908	....	214,061,009	....	196,547,259	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
....	187,549,908	....	214,061,009	....	196,547,259	56
....	6,500,000	....	6,500,000	....	6,500,000	57
....	400,833,052	....	451,901,159	....	446,859,473	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, commercial value.......troy ounces..	37,743,800	41,921,300
3	Gold, coining value.......do....	1,489,950	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.......	....	179,230,899
	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.......	....	179,230,899
58	Estimated value of mineral products unspecified.......	....	5,000,000
59	Grand total.......	....	406,110,405

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

the calendar years 1880–1905—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
39,909,400	42,503,500	39,694,000	39,482,400	41,721,600	40,887,200	2
1,538,373	31,801,000	1,686,788	34,869,000	1,603,049	33,136,000	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
....	172,491,087	....	203,249,225	....	236,598,254	12
64,840,668	82,347,648	73,707,957	78,481,056	87,887,360	98,004,656	13
34,228,548	76,671,948	34,853,077	76,119,120	37,578,747	84,552,181	14
....	19,000,000	....	19,000,000	....	25,000,000	15
21,847,205	19,198,243	28,064,841	19,996,313	28,278,866	18,877,094	16
40,000,000	20,000,000	....	....	....	....	17
....	4,857,200	....	10,012,000	....	15,817,500	18
....	....	....	6,200,000	....	7,000,000	19
40,320	275,000	44,800	325,000	48,160	340,000	20
4,150,000	3,492,500	4,500,000	3,990,000	6,692,744	5,674,377	21
7,038,653	4,825,345	7,707,081	4,736,585	7,831,962	4,093,846	22
437,856	2,846,064	430,549	1,872,936	480,558	1,836,818	23
3,356,956	1,678,478	4,717,163	2,830,297	5,377,000	3,226,200	24
9,148,401	1,312,845	8,950,317	1,284,070	8,259,609	1,261,463	25
15,000	1,050,000	18,000	1,440,000	18,000	1,440,000	26
3,950	43,575	18,800	315,000	22,000	330,000	27
8,000,000	480,000	9,778,290	488,915	11,000,000	550,000	28
90,405	405,000	95,250	428,625	95,000	425,000	29
....	500,000	....	250,000	....	224,400	30
10,000	110,000	12,000	125,000	15,000	160,000	31
49,000	220,500	55,000	220,000	52,000	210,000	32
10,000	200,000	12,000	225,000	12,000	225,000	33
23,258	190,281	30,193	277,636	34,524	333,844	34
3,000	10,500	3,500	14,000	4,000	16,000	35
....	209,900	....	119,056	....	163,600	36
310,000	89,900	428,334	141,350	199,087	61,717	37
600	108,000	645	116,190	600	108,000	38
15,000	75,000	10,000	50,000	15,000	75,000	39
327,883	26,231	415,525	33,242	416,000	34,000	40
....	100,000	....	140,000	....	100,000	41
1,000,000	15,000	1,160,000	15,000	1,200,000	16,000	42
875,000	437,500	800,000	400,000	600,000	300,000	43
30,000	120,000	30,000	120,000	32,000	128,000	44
5,000	22,500	5,000	22,000	5,000	20,000	45
2,700	40,000	2,000	30,000	3,000	40,000	46
1,000	5,000	1,200	6,000	3,000	15,000	47
13,600	68,000	14,900	74,500	10,200	61,200	48
92,000	161,000	40,000	70,000	70,000	142,250	49
68,723	65,373	35,000	36,878	18,340	18,774	50
1,975	24,687	....	....	....	....	51
715	17,875	2,500	75,000	3,000	100,000	52
300	9,000	200	6,000	150	4,500	53
600	2,000	600	2,000	1,000	3,000	54
....	....	....	....	....	....	55
....	241,312,093	....	230,088,769	....	270,989,420	56
....	172,491,087	....	203,249,225	....	236,598,254	57
....	5,000,000	....	800,000	....	800,000	58
....	418,803,180	....	434,137,994	....	508,387,674	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, commercial value ....troy ounces..	45,792,700	43,045,100
3	Gold, coining value ....do....	1,604,478	33,167,500
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	....	237,574,422
	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	....	237,574,422
59	Estimated value of mineral products unspecified	....	900,000
60	Grand total	....	524,624,536

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

the calendar years 1880–1905—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
50,094,500	46,838,400	54,516,300	57,242,100	58,330,000	57,630,000	2
1,594,775	32,967,000	1,588,877	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
....	247,768,701	....	292,649,877	....	282,617,183	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	....	18,792,725	....	15,500,084	18
....	8,000,000	....	8,500,000	....	9,000,000	19
329,665	635,578	392,000	756,000	448,000	900,000	20
7,000,000	5,000,000	8,000,000	6,000,000	8,222,792	6,680,951	21
12,780,471	1,748,458	13,907,418	2,600,750	18,392,732	2,996,259	22
550,245	2,937,776	510,499	3,213,795	587,988	3,651,150	23
8,005,565	4,195,412	8,776,991	4,752,286	9,987,945	4,716,121	24
6,318,000	3,159,000	5,521,622	2,760,811	5,000,000	2,300,000	25
16,970	1,357,600	....	1,600,000	23,700	1,600,000	26
267,769	764,118	182,995	574,523	208,126	628,051	27
8,000,000	500,000	9,500,000	617,500	13,380,000	869,700	28
34,307	483,766	47,732	681,992	49,652	678,478	29
....	439,587	....	450,000	....	476,113	30
23,746	244,170	41,354	389,196	53,054	493,068	31
51,735	171,537	40,841	190,416	45,054	242,264	32
12,715	231,708	13,670	252,309	16,514	243,981	33
....	188,807	....	118,833	....	235,300	34
93,705	202,119	99,854	273,745	106,536	338,880	35
2,245	105,565	1,970	89,395	2,265	90,230	36
5,982,000	32,980	....	69,909	1,375,000	150,000	37
49,500	50,000	60,000	75,000	75,000	100,000	38
19,161	106,313	21,911	86,505	31,069	118,363	39
418,891	125,667	387,847	104,719	343,000	54,880	40
9,500	45,835	8,250	55,328	10,044	78,330	41
6,970	39,370	8,000	45,200	10,000	50,000	42
24,197	240,559	25,684	219,050	23,416	239,129	43
21,113	89,730	13,000	57,400	15,000	60,000	44
....	72,662	....	77,500	....	110,000	45
728	2,366	1,844	6,012	3,593	11,675	46
1,150	7,850	....	....	1,200	39,600	47
139,522	63,956	153,620	69,880	135,000	67,500	48
3,466	23,372	2,532	50,240	....	21,988	49
....	35,155	....	23,720	....	16,587	50
2,000	30,000	3,599	53,985	1,372	20,580	51
13,955	31,092	6,788	16,291	7,200	18,000	52
....	....	....	....	439	4,390	53
30	1,800	71	4,560	66	3,960	54
1,000	3,000	400	1,000	300	800	55
50,000	2,500	350,000	26,250	50,000	7,000	56
....	282,623,812	....	312,826,503	....	321,767,846	57
....	247,768,701	....	292,649,877	....	282,617,183	58
....	1,000,000	....	1,000,000	....	1,000,000	59
....	531,392,513	....	606,476,380	....	605,385,029	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, commercial value ....troy ounces..	63,500,000	55,662,500
3	Gold, coining value ....do....	1,597,098	33,015,000
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	....	281,514,539
	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	....	14,870,714
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	....	340,028,842
63	Total value of metallic products	....	281,514,539
64	Estimated value of mineral products unspecified	....	1,000,000
65	Grand total	....	622,543,381

the calendar years 1880-1905—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	46,800,000	49,500,000	31,422,100	55,727,000	36,445,500	2
1,739,323	35,955,000	1,910,813	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
....	219,436,649	....	185,804,594	....	245,874,431	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	....	[b] 64,655,388	....	[b] 65,409,806	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	....	....	....	....	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	....	362,570,173	....	393,897,097	62
....	219,436,649	....	185,804,594	....	245,874,431	63
....	1,000,000	....	1,000,000	....	1,000,000	64
....	543,693,967	....	549,374,767	....	640,771,528	65

[a] Including copper made from imported pyrites. [b] Clay products.

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, commercial value .... troy ounces..	58,834,800	39,654,600
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 New York City .... troy ounces..	163	944
13	Total value of metallic products	....	251,445,519
	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	Clay products	....	63,110,408
19	Cement .... barrels..	9,513,473	6,473,213
20	Lime	....	6,327,900
21	Slate	....	2,746,205
22	Stone	....	23,965,229
23	Corundum and emery .... short tons..	2,120	113,246
24	Crystalline quartz .... do....	6,000	18,000
25	Garnet for abrasive purposes .... do....	2,686	68,877
26	Grindstones	....	326,826
27	Infusorial earth and tripoli .... short tons..	3,846	26,792
28	Millstones	....	22,567
29	Oilstones, etc	....	127,098
30	Borax .... pounds..	13,508,000	675,400
31	Bromine .... do....	546,580	144,501
32	Fluorspar .... short tons..	6,500	52,000
33	Gypsum .... do....	224,254	573,344
34	Marls .... do....	60,000	30,000
35	Phosphate rock .... long tons..	930,779	2,803,372
36	Pyrite .... do....	115,483	320,163
37	Salt .... barrels..	13,850,726	4,040,839
38	Sulphur .... short tons..	5,260	87,200
39	Barytes (crude) .... do....	17,068	46,513
40	Cobalt oxide .... pounds..	10,700	15,301
41	Mineral paints .... short tons..	43,894	459,089
42	Zinc white .... do....	20,000	1,400,000
43	Asbestos .... do....	504	6,100
44	Asphaltum .... do....	80,503	577,563
45	Bauxite .... long tons..	18,364	47,338
46	Chromic iron ore .... do....	786	6,667
47	Feldspar .... short tons..	10,203	35,200
48	Fibrous talc .... do....	46,089	399,443
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	Quartz (flint) .... do....	12,458	24,226
62	Rutile .... pounds..	100	350
63	Soapstone .... short tons..	22,183	354,065
64	Total value of nonmetallic mineral products	....	388,098,702
65	Total value of metallic products	....	251,445,519
66	Estimated value of mineral products unspecified	....	1,000,000
67	Grand total	....	640,544,221

the calendar years 1880–1905—Continued.

1897.		1898.		1899.		
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
9,652,680	$95,122,299	11,773,934	$116,557,000	13,620,703	$245,172,654	1
53,860,000	32,316,000	54,438,000	32,118,400	54,764,500	32,858,700	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	442,300	3,238	532,101	2,861	559,189	9
23,707	7,823	11,145	3,956	22,541	8,566	10
....	....	....	....	....	....	11
150	900	225	1,913	300	1,800	12
....	265,209,975	....	305,482,183	....	487,831,631	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
....	62,359,991	....	74,487,680	....	95,797,370	18
10,989,463	8,178,283	12,111,208	9,859,501	15,520,445	12,889,142	19
....	6,390,487	....	6,886,549	....	6,983,067	20
....	3,524,614	....	3,723,540	....	3,962,733	21
....	26,876,671	....	28,635,175	....	35,244,717	22
2,165	106,574	4,064	275,064	4,900	150,600	23
7,500	22,500	8,312	23,990	13,600	39,000	24
2,554	80,853	2,967	86,850	2,765	98,325	25
....	368,058	....	489,769	....	675,586	26
3,833	22,835	2,733	16,691	4,334	37,032	27
....	25,932	....	25,934	....	28,115	28
....	149,970	....	180,486	....	208,283	29
16,000,000	1,080,000	16,000,000	1,120,000	40,714,000	1,139,882	30
487,149	129,094	486,979	126,614	433,004	108,251	31
5,062	37,159	7,675	63,050	15,900	96,650	32
288,982	755,864	291,638	755,280	486,235	1,287,080	33
60,000	30,000	60,000	30,000	60,000	30,000	34
1,039,345	2,673,202	1,308,885	3,453,460	1,515,702	5,084,076	35
143,201	391,541	193,364	593,801	174,734	543,249	36
15,973,202	4,920,020	17,612,634	6,212,554	19,708,614	6,867,467	37
2,275	45,590	1,200	32,960	4,830	107,500	38
26,042	58,295	31,306	108,339	41,894	139,528	39
19,520	31,232	6,247	9,371	10,230	18,512	40
47,308	501,029	48,479	534,345	51,020	517,328	41
25,000	1,750,000	33,000	2,310,000	40,146	3,211,680	42
580	6,450	605	10,300	681	11,740	43
75,945	664,632	76,337	675,649	75,085	553,904	44
20,590	57,652	25,149	75,437	35,280	125,598	45
....	....	....	....	....	....	46
12,516	43,100	13,440	32,395	24,202	211,545	47
57,009	396,936	51,356	411,430	54,655	438,150	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
13,466	26,227	21,425	42,670	29,852	180,345	61
100	350	140	700	230	1,030	62
21,923	365,629	22,231	287,112	24,765	330,805	63
....	380,782,607	....	417,790,671	....	525,524,074	64
....	265,209,975	....	305,482,183	....	487,831,631	65
....	1,000,000	....	1,000,000	....	1,000,000	66
....	646,992,582	....	724,272,854	....	1,014,355,705	67

Mineral products of the United States for

	Product.	1900. Quantity.	1900. Value.
	METALLIC.		
1	Pig iron, value at Philadelphia .... long tons..	13,789,242	$259,944,000
2	Silver, commercial value .... troy ounces..	57,647,000	35,741,100
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 New York City .... troy ounces..	400	2,500
13	Total value of metallic products	....	511,632,891
	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	Clay products	....	96,212,345
19	Cement .... barrels..	17,231,150	13,283,581
20	Lime	....	6,797,496
21	Sand-lime brick	....	....
22	Slate	....	4,240,466
23	Stone	....	36,970,777
24	Corundum and emery .... short tons..	4,305	102,715
25	Crystalline quartz .... do....	14,461	40,705
26	Garnet for abrasive purposes .... do....	3,185	123,475
27	Grindstones	....	710,026
28	Infusorial earth and tripoli .... short tons..	3,615	24,207
29	Millstones	....	32,858
30	Oilstones, etc	....	174,087
31	Arsenious oxide .... pounds..	....	....
32	Borax .... short tons..	{ [b] 1,602 [c] 24,235	170,036 848,215
33	Bromine .... pounds..	521,444	140,790
34	Fluorspar .... short tons..	18,450	94,500
35	Gypsum .... do....	594,462	1,627,203
36	Lithium .... do....	520	....
37	Marls .... do....	60,000	30,000
38	Phosphate rock .... long tons..	1,491,216	5,359,248
39	Pyrite .... do....	204,615	749,991
40	Sulphur .... short tons..	3,525	88,100
41	Salt .... barrels..	20,869,342	6,944,603
42	Barytes (crude) .... short tons..	67,680	188,089
43	Cobalt oxide .... pounds..	6,471	11,648
44	Mineral paints .... short tons..	57,426	644,089
45	Zinc white .... do....	48,840	3,667,210
46	Asbestos .... do....	1,054	16,310
47	Asphaltum .... do....	54,389	415,958
48	Bauxite .... long tons..	23,184	89,676
49	Chromic iron ore .... do....	140	1,400
50	Feldspar .... short tons..	24,821	180,971
51	Fibrous talc .... do....	63,500	499,500
52	Fuller's earth .... do....	9,698	67,535
53	Glass sand .... do....	....	....
54	Graphite (crystalline) .... pounds..	5,507,855	} 197,579
55	Graphite (amorphous) .... short tons..	611	
56	Magnesite .... do....	2,252	19,333
57	Manganese ore .... long tons..	11,771	100,289
58	Mica (sheet) .... pounds..	456,283	92,758
59	Mica (scrap) .... short tons..	5,497	55,202
60	Mineral waters .... gallons sold..	47,558,784	6,245,172
61	Monazite and zircon .... pounds..	908,000	48,805
62	Precious stones	....	233,170
63	Pumice stone .... short tons..	....	....
64	Quartz (flint) .... do....	32,495	86,351
65	Rutile .... pounds..	300	1,300
66	Talc and soapstone .... short tons..	27,943	383,541
67	Uranium and vanadium .... do....	....	....
68	Total value of nonmetallic mineral products	....	594,387,461
69	Total value of metallic products	....	511,632,891
70	Estimated value of mineral products unspecified	....	1,000,000
71	Grand total	....	1,107,020,352

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

the calendar years 1880–1905—Continued.

1901.		1902.		1903.		
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
15,878,354	$242,174,000	17,821,307	$372,775,000	18,009,252	$344,350,000	1
55,214,000	33,128,400	55,500,000	29,415,000	54,300,000	29,322,000	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
	480,006,859		599,916,009		583,433,948	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
	110,211,587		122,169,531		131,062,421	18
20,068,737	15,786,789	25,753,504	25,366,380	29,899,140	31,931,341	19
	8,204,054		9,335,618		9,255,882	20
					155,040	21
	4,787,525		5,696,051		6,256,885	22
	47,284,183		54,798,682		57,433,141	23
4,305	146,040	4,251	104,605	2,542	64,102	24
14,050	41,500	15,104	84,335	8,938	76,908	25
4,444	158,100	3,926	132,820	3,950	132,500	26
	580,703		667,431		721,446	27
4,020	52,950	5,665	53,244	9,219	76,273	28
	57,179		59,808		52,552	29
	158,300		221,762		366,857	30
600,000	18,000	2,706,000	81,180	1,222,000	36,691	31
b 5,344 c 17,887	697,307 314,811	b 17,404 c 2,600	2,447,614 91,000	c 34,430	661,400	32
552,043	154,572	513,893	128,472	598,500	167,580	33
19,586	113,803	48,018	271,832	42,523	213,617	34
633,791	1,506,641	816,478	2,089,341	1,041,704	3,792,943	35
1,750	43,200	1,245	25,750	1,155	23,425	36
99,880	124,880	12,439	12,741	34,211	22,521	37
1,483,723	5,316,403	1,490,314	4,693,444	1,581,576	5,319,294	38
241,691 (d)	1,257,879 (d)	207,874 (d)	947,089 (d)	d 233,127	1,109,818	39 40
20,566,661	6,617,449	23,849,231	5,668,636	18,968,089	5,286,988	41
49,070	157,844	61,668	203,154	50,397	152,150	42
13,360	24,048	3,730	6,714	120,000	228,000	43
52,209	636,145	60,191	745,227	56,262	500,922	44
46,500	3,720,000	52,645	4,016,499	62,962	4,801,718	45
747	13,498	1,005	16,200	887	16,760	46
63,134	555,335	105,458	765,048	101,255	1,005,446	47
18,905	79,914	27,322	120,366	48,087	171,306	48
368	5,790	315	4,567	150	2,250	49
34,741	220,422	45,287	250,424	41,891	256,733	50
69,200	483,600	71,100	615,350	60,230	421,600	51
14,112	96,835	11,492	98,144	20,693	190,277	52
		943,135	807,797	823,044	855,828	53
3,967,612 809	167,714	3,936,824 4,739	182,108	4,538,155 16,591	225,554	54 55
3,500	10,500	2,830	8,490	3,744	10,595	56
11,995	116,722	7,477	60,911	2,825	25,335	57
360,060	98,859	373,266	83,843	619,600	118,088	58
2,171	19,719	1,400	35,006	1,659	25,040	59
55,771,188	7,586,962	64,859,451	8,793,761	51,242,757	9,041,078	60
748,736	59,262	802,000	64,160	865,000	65,200	61
	289,050		328,450		307,900	62
		700	2,750	885	2,665	63
34,420	149,297	36,365	144,209	55,233	156,947	64
44,250	5,710	(e)				65
28,643	424,888	26,854	525,157	e 26,671	418,460	66
375		3,810	48,125	30	5,625	67
	660,965,450		722,152,668		907,451,393	68
	480,006,859		599,916,009		583,433,948	69
	1,000,000		1,000,000		1,000,000	70
	1,141,972,309		1,323,068,677		1,491,885,341	71

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

Mineral products of the United States for the calendar years 1880–1905—Continued.

Product.	1904. Quantity.	1904. Value.	1905. Quantity.	1905. Value.
METALLIC.				
Pig iron (spot value) .... long tons..	16,497,033	$233,025,000	22,992,380	$382,450,000
Silver, commercial value .... troy ounces..	55,999,864	32,035,378	56,101,600	34,221,976
Gold, coining value .... do....	3,910,729	80,835,648	4,265,742	88,180,700
Copper, value at New York City ..... pounds..	812,537,267	105,629,845	901,907,843	139,795,716
Lead, value at New York City .... short tons..	307,000	26,402,000	302,000	28,690,000
Zinc, value at New York City .... do....	186,702	18,670,200	203,849	24,054,182
Quicksilver, value at San Francisco.. [a] flasks..	34,570	1,503,795	30,451	1,103,120
Aluminum, value at Pittsburg .... pounds..	[b] 8,600,000	[b] 2,477,000	[b] 11,347,000	3,246,300
Antimony, value at San Francisco, short tons	3,057	505,524	3,240	705,787
Nickel, value at Philadelphia .... pounds..	24,000	11,400	....	([c])
Tin .... do....	([d])	....	None.	....
Platinum, value (crude) at New York City, troy ounces	200	4,160	318	5,320
Total value of metallic products	....	501,099,950	....	702,453,101
NONMETALLIC (spot values).				
Bituminous coal .... short tons..	278,659,689	305,397,001	315,259,491	334,877,963
Pennsylvania anthracite .... long tons..	65,318,490	138,974,020	69,339,152	141,879,000
Natural gas	....	38,496,760	....	41,562,855
Petroleum .... barrels..	117,080,960	101,175,455	134,717,580	84,157,399
Clay products	....	131,023,248	....	149,697,188
Cement .... barrels..	31,675,257	26,031,920	40,102,308	35,931,533
Lime .... short tons..	2,707,809	9,951,456	2,984,100	10,941,680
Sand-lime brick	....	463,128	....	972,064
Slate	....	5,617,195	....	5,496,207
Stone	....	58,765,715	....	63,798,748
Corundum and emery .... short tons..	1,916	56,985	2,126	61,464
Crystalline quartz .... do....	31,940	74,850	19,039	88,118
Garnet for abrasive purposes .... do....	3,854	117,581	5,050	148,095
Grindstones	....	881,527	....	777,606
Infusorial earth and tripoli .... short tons..	6,274	44,164	10,977	64,637
Millstones	....	37,338	....	37,974
Oilstones, etc	....	188,985	....	244,546
Arsenious oxide .... pounds..	72,413	2,185	1,507,386	35,210
Borax (crude) .... short tons..	45,647	698,810	46,334	1,019,154
Bromine .... pounds..	897,100	269,130	1,192,758	178,914
Fluorspar .... short tons..	36,452	234,755	57,385	362,488
Gypsum .... do....	940,917	2,784,325	1,043,202	3,029,227
Lithium minerals .... do....	577	5,155	21	252
Marls .... do....	18,989	13,145	38,026	16,494
Phosphate rock .... long tons..	1,874,428	6,580,875	1,947,190	6,763,403
Pyrite ... } do....	334,373	3,478,568	253,000	938,492
Sulphur [e] }			181,677	3,706,560
Salt .... barrels..	22,030,002	6,021,222	25,966,122	6,095,922
Barytes (crude) .... short tons..	65,727	174,958	48,235	148,803
Cobalt oxide .... pounds..	22,000	42,600	....	([c])
Mineral paints .... short tons..	52,336	493,434	56,599	724,933
Zinc white .... do....	63,363	4,808,482	68,603	5,520,240
Asbestos .... do....	1,480	25,740	3,109	42,975
Asphaltum .... do....	108,572	879,836	115,267	758,153
Bauxite .... long tons..	47,661	235,704	48,129	240,292
Chromic iron ore .... do....	123	1,845	25	375
Feldspar .... short tons..	45,188	266,326	35,419	226,157
Fibrous talc .... do....	64,005	507,400	56,500	445,000
Fuller's earth .... do....	29,480	168,500	25,178	214,497
Glass sand .... do....	858,719	796,492	1,030,334	1,083,730
Graphite { Crystalline .... pounds..	5,681,177	321,372	6,036,567	318,211
Graphite { Amorphous .... short tons..	16,927		21,953	
Magnesite .... do....	2,850	9,298	3,933	15,221
Manganese ore .... long tons..	3,146	29,466	4,118	36,214
Mica { Sheet .... pounds..	668,358	109,462	851,800	185,900
Mica { Scrap .... short tons..	1,096	10,854	856	15,255
Mineral waters .... gallons sold..	50,723,500	7,198,450	47,590,081	6,811,611
Monazite and zircon .... pounds..	745,999	85,038	1,352,418	163,908
Precious stones	....	324,300	....	326,350
Pumice stone .... short tons..	1,530	5,421	1,832	5,540
Quartz (flint) .... do....	52,270	100,590	51,145	104,109
Rutile .... pounds..	....	7,000	....	....

[a] Of $76\frac{1}{2}$ avoirdupois pounds net; of 75 avoirdupois pounds net after June, 1904.
[b] Consumption in 1904.
[c] Included under unspecified.
[d] About 159 short tons of concentrates from South Carolina, South Dakota, and Alaska shipped to England in 1904.
[e] Included under pyrite since 1901.

Mineral products of the United States for the calendar years 1880–1905—Continued.

Product.	1904.		1905.	
	Quantity.	Value.	Quantity.	Value.
NONMETALLIC (spot values)—continued.				
Sand, molding, building, etc., and gravel, short tons	9,821,009	$4,951,607	22,144,633	$10,115,915
Talc and soapstone short tons..	27,184	433,331	40,134	637,062
Uranium and vanadium do....	45	10,600	4	375
Total value of nonmetallic mineral products	....	859,383,604	....	921,024,019
Total value of metallic products	....	501,099,950	....	702,453,101
Estimated value of mineral products unspecified	....	400,000	....	400,000
Grand total	....	1,360,883,554	....	1,623,877,120

VALUE, BY STATES, OF THE MINERAL PRODUCTS OF THE UNITED STATES IN THE CALENDAR YEAR 1905.

Compiled by WM. TAYLOR THOM.

In the following table is shown the value, by States, of the mineral products of the United States in 1905, including both certain raw materials and also certain derivative materials in their first marketable condition, which do not appear in the table of mineral products of the United States as a whole. For example, both pig iron and iron ores are included as important products entering into the commerce of certain States; and in like manner are included both pig lead and lead paints; both clay products and raw clay; both coal and its immediate derivatives, coke, gas coke, illuminating gas, ammonium sulphate, and coal tar; both bauxite and aluminum, and also alum and aluminum sulphate.

These derivatives and raw materials are here given, regardless of the consequent duplication of values, in response to a constant demand for this information thus arranged by States. Unfortunately, it has not been possible to give separately the values of all of the products under the respective States because of the necessity of preventing the disclosure of individual returns. These values will be found grouped together under the headings "Other products" and "Miscellaneous," except in those few cases in which the products of two or more States are combined.

The values for gold and silver given under the different States are the values for the output reported to the United States Geological Survey directly from the producing mines.

Value, by States, of mineral products of the United States in the calendar year 1905.

ALABAMA.

Clay	$22, 924
Clay products	1, 392, 871
Coal	14, 387, 721
Coke	7, 646, 957
Ammonium sulphate	[a]253, 453
Car tar	128, 271
Gas, illuminating	429, 817
Gas coke	1, 157, 987
Glass sand	130
Gold (mines report)	41, 530
Iron ores	4, 257, 155
Pig	[b]22, 680, 000
Lime	292, 162
Mineral waters	23, 704
Sand and gravel	93, 022
Sand-lime brick	23, 727
Silver (mines report)	203
Stone	560, 210
Other products, including bauxite, cement, graphite, natural gas, and pyrite	193, 444
Total	53, 585, 288

[a] Includes Georgia.
[b] Estimated.

ALASKA.

Coal	$13, 250
Copper	759, 634
Gold (mines report)	15, 630, 000
Lead	([c])
Silver (mines report)	80, 165
Stone	710
Total	16, 483, 759

ARIZONA.

Clay products	$90, 436
Copper	36, 565, 763
Gold (mines report)	2, 799, 214
Lead	188, 670
Lime	32, 557
Silver (mines report)	1, 573, 850
Stone	69, 393
Other products, including asbestos, clay, molybdenum, mineral waters, sand-lime brick, and tungsten	26, 251
Total	41, 346, 134

[c] Included under Miscellaneous

Value, by States, of mineral products of the United States, etc.—Continued.

ARKANSAS.

Asphaltum	$3,000
Bauxite	164,780
Clay products	643,959
Coal	2,880,738
Coal tar	3,677
Gas, illuminating	72,026
Gas coke	3,894
Iron ores	6,642
Lime	114,846
Mineral waters	50,501
Sand and gravel	50,485
Slate	10,000
Stone	304,291
Other products, including natural gas, oilstones, and sand-lime brick	161,945
Total	4,470,784

CALIFORNIA.

Asphaltum	$568,403
Borax	1,019,154
Cement, Portland	1,671,816
Chromite	375
Clay	50,290
Clay products	3,865,147
Coal	382,725
Coal tar	2,212
Gas, illuminating	47,793
Gas coke	16,384
Copper	2,588,111
Glass sand	8,122
Gold (mines report)	18,898,545
Lead	10,450
Lime	535,157
Lithium minerals	252
Magnesite	15,221
Manganese ores	5
Mineral waters	675,214
Natural gas	133,696
Ocher	5,900
Petroleum	8,201,846
Platinum	3,320
Pyrite	247,712
Quicksilver	886,081
Salt	188,330
Sand and gravel	62,985
Sand-lime brick	34,689
Silver (mines report)	650,009
Slate	40,000
Stone	2,531,928
Other products, including asbestos, gypsum, infusorial earth, metallic paint, talc, and tungsten	64,386
Total	43,406,258

COLORADO.

Bismuth	$4,187
Clay	42,669
Clay products	1,633,231
Coal	10,810,978
Coke	[a]4,157,517
Ammonium sulphate	[b]9,289
Coal tar	26,758
Gas, illuminating	556,917
Gas coke	140,673
Copper	1,457,749
Fluorspar	8,200
Glass sand	1,875
Gold (mines report)	25,023,973
Iron ores	398,700
Pig	([c])
Lead	5,111,570
Lime	48,459
Mineral waters	130,623
Natural gas	20,752
Petroleum	337,606
Sand and gravel	12,870
Silver (mines report)	6,945,581
Stone	816,751
Uranium and vanadium	[a]375
Zinc	778,682
Other products, including cement, graphite, mica, sand-lime brick, and tungsten	804,959
Total	59,280,944

CONNECTICUT.

Clay products	[d]1,608,578
Coal products:	
Ammonium sulphate	([e])
Coal tar	35,980
Gas, illuminating	579,553
Gas coke	133,407
Feldspar	[f]107,536
Flint	([g])
Iron, pig	[h]220,000
Lime	261,509
Mineral waters	23,362
Sand and gravel	6,958
Stone	1,014,064
Other products, including clay, crystalline quartz, infusorial earth, and iron ores	107,678
Total	4,098,625

DELAWARE.

Clay products	$227,064
Coal products:	
Ammonium sulphate	([g])
Coal tar	2,725

[a] Includes Utah.
[b] Includes Washington.
[c] Included under Miscellaneous.
[d] Includes Rhode Island.
[e] Included under Rhode Island.
[f] Includes Maine and New York.
[g] Included under Maryland.
[h] Estimated.

Value, by States, of mineral products of the United States, etc.—Continued.

DELAWARE—Continued.

Coal products—Continued.	
Gas, illuminating	$61, 226
Gas coke	12, 740
Sand and gravel	65, 181
Stone	178, 428
Other products, including clay, pigments (unclassified), and sand-lime brick	215, 580
Total	762, 944

DISTRICT OF COLUMBIA.

Clay products	$317, 021
Coal products:	
Ammonium sulphate	([a])
Coal tar	([a])
Gas, illuminating	([a])
Gas coke	([a])
Mineral waters	([b])
Total	317, 021

FLORIDA.

Clay products	$329, 738
Coal products:	
Coal tar	([c])
Gas, illuminating	([c])
Gas coke	([c])
Lime	63, 950
Mineral waters	28, 170
Phosphate rock	4, 251, 845
Stone	5, 800
Other products, including pottery, sand and gravel, and sand-lime brick	149, 280
Total	4, 828, 783

GEORGIA.

Cement, natural	$51, 040
Clay	102, 467
Clay products	2, 119, 746
Coal	[d]456, 184
Coke	224, 260
Ammonium sulphate	([e])
Coal tar	24, 604
Gas, illuminating	491, 138
Gas coke	101, 181
Glass sand	4, 050
Gold (mines report)	96, 910
Iron, pig	([b])
Lime	49, 580
Manganese ores	900
Mineral waters	37, 619
Ocher	43, 481
Sand and gravel	37, 203

GEORGIA—Continued.

Silver (mines report)	$628
Slate	7, 500
Stone	1, 754, 787
Other products, including asbestos, bauxite, Portland cement, graphite, infusorial earth, iron ores, mica, pyrite, and talc	697, 376
Total	6, 300, 654

IDAHO.

Clay products	$212, 780
Coal	[f]17, 846
Coal tar	([g])
Gas, illuminating	([g])
Coal tar	([g])
Copper	1, 134, 846
Gold (mines report)	1, 075, 618
Lead	8, 937, 125
Lime	44, 733
Pumice	([h])
Silver (mines report)	5, 242, 172
Stone	37, 870
Zinc	([b])
Other products, including clay, mineral waters, and salt	65, 865
Total	16, 768, 855

ILLINOIS.

Cement, natural	$116, 549
Portland	1, 741, 150
Clay	120, 410
Clay products	12, 361, 786
Coal	40, 577, 592
Coke	27, 681
Ammonium sulphate	22, 956
Coal tar	49, 714
Gas, illuminating	1, 912, 868
Gas coke	487, 772
Fluorspar	220, 206
Glass sand	146, 605
Iron, pig	[i]37, 040, 000
Lead	([b])
Lime	421, 589
Mineral waters	47, 995
Natural gas	7, 223
Petroleum	116, 561
Sand and gravel	547, 167
Stone	3, 541, 005
Zinc	5, 499, 508
Other products, including slag cement and sand-lime brick	59, 230
Total	105, 065, 567

[a] Included under Maryland.
[b] Included under Miscellaneous.
[c] Included under Louisiana.
[d] Includes North Carolina.
[e] Included under Alabama.
[f] Includes Nevada.
[g] Included under Utah.
[h] Included under Nebraska.
[i] Estimated.

Value, by States, of mineral products of the United States, etc.—Continued.

INDIANA.

Cement, natural	$211, 040
Portland	3, 134, 219
Clay	79, 945
Clay products	6, 499, 573
Coal	12, 492, 255
Ammonium sulphate	22, 630
Coal tar	44, 198
Gas, illuminating	1, 169, 947
Gas coke	303, 354
Glass sand	2, 169
Lime	366, 866
Mineral waters	435, 182
Natural gas	3, 094, 134
Oilstones	([a])
Petroleum	9, 404, 909
Pyrite	11, 491
Sand and gravel	1, 239, 181
Sand-lime brick	65, 905
Stone	3, 204, 680
Total	41, 781, 678

INDIAN TERRITORY.

Asphaltum	$27, 790
Clay products	374, 235
Coal	5, 145, 358
Coal tar	[b]3, 323
Gas, illuminating	[b]55, 792
Gas coke	[b]16, 551
Lime	650
Mineral waters	([a])
Natural gas	[b]130, 137
Petroleum	([c])
Stone	9, 510
Total	5, 763, 346

IOWA.

Clay products	$3, 392, 122
Coal	10, 586, 381
Coal tar	14, 775
Gas, illuminating	633, 557
Gas coke	179, 533
Gypsum	589, 055
Lead	([a])
Lime	76, 904
Mineral waters	31, 300
Sand and gravel	92, 287
Sand-lime brick	38, 652
Stone	461, 126
Other products, including clay, iron ores, and ocher	2, 336
Total	16, 098, 028

KANSAS.

Clay products	$1, 906, 360
Coal	9, 350, 542
Coke	13, 818
Coal tar	10, 898
Gas, illuminating	194, 310
Gas coke	35, 260
Gypsum	150, 402
Lead	([a])
Lime	17, 242
Mineral waters	47, 708
Natural gas	2, 261, 836
Petroleum	[d] 6, 546, 398
Salt	576, 139
Sand and gravel	21, 552
Stone	1, 003, 006
Zinc	13, 485, 866
Other products, including cement, pottery, and sand-lime brick	2, 349, 861
Total	37, 971, 198

KENTUCKY.

Asphaltum	$66, 420
Barytes	([e])
Cement, natural	83, 000
Clay	57, 090
Clay products	2, 406, 350
Coal	8, 385, 232
Coke	159, 659
Ammonium sulphate	15, 495
Coal tar	17, 942
Gas, illuminating	539, 724
Gas coke	183, 100
Fluorspar	132, 362
Glass sand	480
Iron, pig	[f] 1, 120, 000
Lead	([a])
Lime	28, 393
Mineral waters	42, 415
Natural gas	[g] 237, 590
Petroleum	[g] 43, 211
Sand and gravel	282, 464
Stone	1, 025, 044
Other products, including cement, iron ores, and sand-lime brick	45, 840
Total	14, 871, 811

LOUISIANA.

Clay products	$821, 109
Coal products:	
Coal tar	[h] 5, 710
Gas, illuminating	[h] 90, 989
Gas coke	[h] 26, 313

[a] Included under Miscellaneous.
[b] Includes Oklahoma.
[c] Included under Kansas.
[d] Includes Indian Territory and Oklahoma.
[e] Included under Tennessee.
[f] Estimated.
[g] Includes Tennessee.
[h] Includes Florida and Mississippi.

Value, by States, of mineral products of the United States, etc.—Continued.

LOUISIANA—Continued.

Mineral waters	$62, 106
Natural gas	1, 500
Petroleum	1, 601, 325
Salt	303, 507
Sand and gravel	189, 962
Sulphur	[a]3, 706, 560
Other products	6, 349
Total	6, 815, 430

MAINE.

Clay products	$619, 294
Coal products:	
Ammonium sulphate	([b])
Coal tar	9, 983
Gas, illuminating	212, 257
Gas coke	51, 253
Copper	([c])
Feldspar	([d])
Lime	971, 305
Mineral waters	246, 159
Slate	224, 254
Stone	2, 721, 223
Other products, including pottery, sand, and gravel	10, 076
Total	5, 065, 804

MARYLAND.

Cement, natural	$28, 694
Clay	24, 405
Clay products	2, 249, 367
Coal	5, 831, 760
Ammonium sulphate	[e]434, 385
Coal tar	[f]87, 512
Gas, illuminating	[f]596, 358
Gas coke	1, 334, 266
Feldspar	[g]118, 621
Flint	[h]73, 450
Glass sand	20, 108
Gold (mines report)	14, 821
Iron ores	14, 291
Pig	[i] 5, 850, 000
Lime	360, 247
Metallic paint and mortar colors	3, 812
Mineral waters	44, 627
Sand and gravel	416, 720
Silver (mines report)	56
Slate	151, 215
Stone	1, 257, 838
Other products, including slag cement, coke, sand-lime brick, and talc	1, 135, 704
Total	20, 048, 257

MASSACHUSETTS.

Clay products	$2, 050, 457
Coal products:	
Ammonium sulphate	377, 260
Coal tar	285, 666
Gas, illuminating	3, 574, 116
Gas coke	2, 247, 074
Glass sand	12, 000
Iron, pig	[i]60, 000
Lime	395, 326
Mineral waters	208, 419
Sand and gravel	118, 086
Stone	3, 263, 058
Other products, including asbestos, clay, coke, emery, infusorial earth, iron ores, pyrite, salt, and talc	1, 432, 738
Total	14, 024, 200

MICHIGAN.

Bromine	[j]$178, 914
Cement, Portland	2, 921, 507
Clay	3, 354
Clay products	1, 765, 707
Coal	2, 512, 697
Ammonium sulphate	271, 333
Coal tar	116, 809
Gas, illuminating	2, 325, 377
Gas coke	1, 592, 253
Copper	35, 694, 639
Grindstones	111, 500
Gypsum	634, 434
Iron ores	23, 367, 233
Pig	[i]5, 750, 000
Lime	192, 844
Mineral waters	277, 188
Salt	1, 851, 332
Sand and gravel	210, 609
Sand-lime brick	169, 302
Silver (mines report)	152, 819
Stone	667, 877
Other products, including asbestos, coke, graphite, petroleum, and whetstones	992, 413
Total	81, 760, 141

MINNESOTA.

Clay products	$1, 499, 386
Coal products:	
Ammonium sulphate	59, 724
Coal tar	54, 823
Gas, illuminating	842, 599
Gas coke	569, 964
Iron ores	35, 895, 001
Pig	([c])
Lime	81, 093
Mineral waters	132, 970

[a] Includes Nevada and Utah.
[b] Included under New Hampshire
[c] Included under Miscellaneous.
[d] Included under Connecticut.
[e] Includes District of Columbia and Delaware.
[f] Includes District of Columbia.
[g] Includes Pennsylvania.
[h] Includes Pennsylvania and Connecticut.
[i] Estimated.
[j] Includes Ohio and West Virginia.

Value, by States, of mineral products of the United States, etc.—Continued.

MINNESOTA—Continued.

Sand and gravel	$71, 375
Stone	1, 331, 949
Other products, including cement, coke, feldspar, pottery and sand-lime brick	766, 491
Total	41, 305, 375

MISSISSIPPI.

Clay products	$818, 897
Coal products:	
Coal tar	([a])
Gas, illuminating	([a])
Gas coke	([a])
Mineral waters	53, 347
Sand and gravel	2, 035
Sand-lime brick	([b])
Total	874, 279

MISSOURI.

Barytes	$84, 095
Clay	322, 425
Clay products	6, 203, 411
Coal	6, 291, 661
Coke	4, 072
Ammonium sulphate	56, 597
Coal tar	86, 515
Gas, illuminating	1, 556, 117
Gas coke	439, 920
Copper	([b])
Glass sand	66, 401
Iron ores	161, 878
Pig	([b])
Lead	([b])
Lime	787, 069
Mineral waters	77, 480
Natural gas	7, 390
Sand and gravel	668, 153
Stone	2, 446, 429
Zinc	1, 397, 592
Other products, including cement, grindstones, infusorial earth, petroleum, pigments (unclassified), zinc white	2, 378, 694
Total	23, 035, 899

MONTANA.

Clay	$33, 983
Clay products	313, 006
Coal	2, 823, 350
Coke	211, 351
Coal tar	([c])
Gas, illuminating	([c])
Gas coke	([c])

MONTANA—Continued

Copper	$48, 786, 340
Gold (mines report)	4, 794, 083
Lead	199, 215
Lime	22, 436
Silver (mines report)	7, 991, 705
Stone	274, 669
Zinc	([b])
Other products, including abrasive corundum, grindstones, gypsum, iron ores, mineral waters, molybdenum, pottery, and tungsten	50, 911
Total	65, 501, 049

NEBRASKA.

Clay products	$1, 006, 743
Coal products:	
Coal tar	2, 426
Gas, illuminating	83, 563
Gas coke	26, 135
Pumice	[d]5, 540
Sand and gravel	8, 200
Sand-lime brick	([b])
Stone	225, 239
Total	1, 357, 846

NEVADA.

Coal	([e])
Coal tar	[f] $3, 496
Gas, illuminating	[f]114, 953
Gas coke	[f]26, 348
Copper	64, 060
Gold (mines report)	5, 269, 819
Lead	199, 025
Silver (mines report)	3, 915, 177
Stone	1, 500
Sulphur	([a])
Other products, including clay products, graphite, gypsum, iron ores, and salt	279, 007
Total	9, 873, 385

NEW HAMPSHIRE.

Clay products	$554, 734
Coal products:	
Ammonium sulphate	[g]3, 578
Coal tar	[h]13, 177
Gas, illuminating	[h]255, 540
Gas coke	[h]74, 863
Mineral waters	197, 350
Stone	838, 371
Other products, including mica, pottery, and whetstones	91, 025
Total	2, 028, 638

[a] Included under Louisiana.
[b] Included under Miscellaneous.
[c] Included under Nevada.
[d] Includes Idaho and South Dakota.
[e] Included under Idaho.
[f] Includes Montana and New Mexico.
[g] Includes Maine.
[h] Includes Vermont.

Value, by States, of mineral products of the United States, etc.—Continued.

NEW JERSEY.

Cement, Portland	$2,775,768
Clay	616,459
Clay products	16,699,525
Coal products:	
Ammonium sulphate	96,752
Coal tar	84,243
Gas, illuminating	1,585,683
Gas coke	643,984
Glass sand	30,005
Iron ores	1,269,374
Pig	[a]5,150,000
Lime	168,775
Marl	[b]16,494
Mineral waters	45,397
Sand and gravel	749,344
Slate	5,360
Stone	1,276,781
Zinc	([c])
Other products, including slag cement, coke, metallic paint, pigments (unclassified), pyrite, sand-lime brick, talc	604,177
Total	31,818,121

NEW MEXICO.

Clay products	$141,722
Coal	2,190,231
Coke	253,229
Gas, illuminating	([d])
Gas coke	([d])
Copper	826,800
Gold (mines report)	317,510
Lead	111,055
Lime	2,625
Mineral waters	16,020
Silver (mines report)	222,992
Stone	110,922
Zinc	([c])
Other products, including gypsum, iron ores, mica, and salt	189,008
Total	4,382,114

NEW YORK.

Cement, natural	$1,332,809
Portland	2,044,253
Clay	18,161
Clay products	14,486,347
Coal products:	
Ammonium sulphate	171,946
Coal tar	189,866
Gas, illuminating	5,090,057
Gas coke	1,335,345

NEW YORK—Continued.

Feldspar	([e])
Flint	([f])
Glass sand	$3,115
Gypsum	771,138
Iron ores	3,197,919
Pig	[a]19,940,000
Lime	490,845
Metallic paint and mortar colors	76,990
Millstones	25,915
Mineral waters	652,680
Natural gas	623,251
Petroleum	1,557,630
Pyrite	39,883
Salt	2,167,931
Sand and gravel	1,703,431
Sand-lime brick	123,104
Slate	66,646
Stone	5,364,222
Talc, fibrous	445,000
Other products, including aluminum, coke, emery, abrasive garnet, graphite, infusorial earth, shale, and sienna	3,137,803
Total	65,056,287

NORTH CAROLINA.

Barytes	$21,545
Clay	86,141
Clay products	1,020,161
Coal	([g])
Coal tar	4,355
Gas, illuminating	86,011
Gas coke	29,253
Copper	([c])
Flint	[h]30,659
Gold (mines report)	125,685
Lime	7,980
Mica	88,275
Millstones	2,522
Mineral waters	33,744
Monazite and zircon	[i]163,908
Sand-lime brick	29,103
Silver (mines report)	12,219
Stone	585,561
Other products, including abrasive corundum and garnet, graphite, iron ores, sand and gravel, and talc	158,941
Total	2,486,063

[a] Estimated.
[b] Includes Virginia.
[c] Included under Miscellaneous.
[d] Included under Nevada.
[e] Included under Connecticut.
[f] Included under North Carolina.
[g] Included under Georgia.
[h] Includes New York.
[i] Includes South Carolina and South Dakota.

Value, by States, of mineral products of the United States, etc.—Continued.

NORTH DAKOTA.

Clay products	$232,432
Coal	424,778
Coal tar	([a])
Gas, illuminating	([a])
Gas coke	([a])
Stone	1,055
Other products, including cement, clay, and mineral waters	7,215
Total	665,480

OHIO.

Bromine	([b])
Cement, Portland	$1,390,481
Clay	217,302
Clay products	28,303,039
Coal	26,486,740
Coke	970,897
Ammonium sulphate	88,243
Coal tar	270,325
Gas, illuminating	3,280,672
Gas coke	1,446,382
Glass sand	79,999
Grindstones	644,315
Iron ores	26,624
Pig	[c]75,530,000
Lime	1,056,721
Metallic paint and mortar colors	20,360
Mineral waters	117,733
Natural gas	5,721,462
Petroleum	17,054,877
Pyrite	32,770
Salt	565,946
Sand and gravel	1,033,763
Sand-lime brick	14,058
Stone	4,595,265
Other products, including cement, gypsum, and oilstones	255,736
Total	169,203,710

OKLAHOMA.

Clay products	$222,064
Coal products:	
Coal tar	([d])
Gas, illuminating	([d])
Gas coke	([d])
Lime	4,000
Natural gas	([d])
Petroleum	([e])
Stone	195,246
Other products, including gypsum, mineral waters, salt, and sand and gravel	202,023
Total	623,333

OREGON.

Clay products	$380,575
Coal	282,495
Coal tar	2,145
Gas, illuminating	39,675
Gas coke	8,946
Copper	([f])
Gold (mines report)	1,405,235
Lead	([f])
Lime	74,745
Mineral waters	8,107
Platinum	2,000
Quicksilver	1,677
Silver (mines report)	54,744
Stone	95,159
Other products, including gypsum, nickel ore, pottery, and sand-lime brick	86,470
Total	2,441,973

PENNSYLVANIA.

Cement, natural	$306,555
Portland	11,195,940
Clay	406,388
Clay products	19,124,553
Coal:	
Anthracite	141,879,000
Bituminous	113,390,507
Coke	42,253,178
Ammonium sulphate	620,068
Coal tar	319,201
Gas, illuminating	2,268,505
Gas coke	3,903,634
Feldspar	([g])
Flint	([g])
Glass sand	482,937
Iron ores	1,060,162
Pig	[c]177,090,000
Lime	1,672,267
Metallic paint and mortar colors	123,570
Millstones	1,351
Mineral waters	194,113
Natural gas	19,197,336
Ocher	72,360
Petroleum	14,653,278
Sand and gravel	1,753,372
Sand-lime brick	63,226
Slate	3,491,905
Stone	7,956,177
Umber	9,704
Other products, including aluminum, slag cement, abrasive garnet, graphite, pigments (unclassified), crystalline quartz, salt, shale, sienna, talc, and zinc white	6,339,386
Total	569,828,673

[a] Included under Utah.
[b] Included under Michigan.
[c] Estimated.
[d] Included under Indian Territory.
[e] Included under Kansas.
[f] Included under Miscellaneous.
[g] Included under Maryland.

Value, by States, of mineral products of the United States, etc.—Continued.

RHODE ISLAND.

Clay products	([a])
Coal products:	
Ammonium sulphate	[b]$8,868
Coal tar	20,400
Gas, illuminating	548,633
Gas coke	135,018
Graphite	([c])
Lime	42,743
Mineral waters	15,469
Stone	556,664
Total	1,327,795

SOUTH CAROLINA.

Clay	$146,790
Clay products	749,835
Coal products:	
Coal tar	5,315
Gas, illuminating	159,709
Gas coke	42,992
Gold (mines report)	95,111
Lime	34,440
Mineral waters	78,837
Monazite	([d])
Phosphate rock	878,169
Silver (mines report)	67
Stone	297,284
Other products, including sand and gravel, and sand-lime brick	5,908
Total	2,494,457

SOUTH DAKOTA.

Clay products	$58,271
Columbite	([d])
Gold (mines report)	6,989,492
Lead	([c])
Lime	26,308
Natural gas	15,200
Pumice	([e])
Silver (mines report)	110,381
Stone	200,061
Other products, including cement, clay, copper, gypsum, mica, mineral waters, pyrite, sand-lime brick, and tungsten	171,860
Total	7,571,573

TENNESSEE.

Barytes	[f]$15,325
Clay	94,201
Clay products	1,493,279
Coal	$6,797,550
Coke	1,184,442
Ammonium sulphate	5,135
Coal tar	29,663
Gas, illuminating	434,718
Gas coke	135,790
Copper	([c])
Fluorspar	1,720
Gold (mines report)	4,362
Iron ores	918,850
Pig	[g]5,260,000
Lime	252,908
Manganese ores	100
Metallic paints and mortar colors	36,380
Mineral waters	135,861
Natural gas	([h])
Petroleum	([h])
Phosphate rock	1,633,389
Sand and gravel	157,594
Sand-lime brick	([c])
Silver (mines report)	57,695
Stone	992,566
Zinc	([c])
Total	19,641,528

TEXAS.

Clay products	$1,718,945
Coal	1,968,558
Coal tar	15,140
Gas, illuminating	253,566
Gas coke	54,531
Gold (mines report)	248
Iron, pig	([c])
Lead	([c])
Lime	142,470
Mineral waters	144,421
Petroleum	7,552,262
Quicksilver	173,362
Salt	142,993
Sand and gravel	146,462
Silver (mines report)	234,054
Stone	427,321
Other products, including cement, clay, gypsum, iron ores, natural gas, and sand-lime brick	778,013
Total	13,752,346

UTAH.

Asphaltum	$92,540
Clay products	544,578

[a] Included under Connecticut.
[b] Includes Connecticut.
[c] Included under Miscellaneous.
[d] Included under North Carolina.
[e] Included under Nebraska.
[f] Includes small production from Kentucky.
[g] Estimated.
[h] Included under Kentucky.

Value, by States, of mineral products of the United States, etc.—Continued.

UTAH—Continued.

Coal	$1,793,510
Coke	[a]
Coal tar	[b] 6,830
Gas, illuminating	[b] 166,705
Gas coke	[b] 42,923
Copper	9,013,776
Gold (mines report)	5,140,920
Lead	4,160,870
Lime	69,089
Quicksilver	42,000
Salt	135,465
Silver (mines report)	6,666,028
Stone	290,728
Sulphur	[c]
Uranium and vanadium	[a]
Zinc	[d]
Other products, including cement, gypsum, iron ores, pottery, and sand and gravel	281,837
Total	28,447,799

VERMONT.

Clay products	$112,967
Coal products:	
Coal tar	[e]
Gas, illuminating	[e]
Gas coke	[e]
Copper	[d]
Lime	188,921
Mineral waters	20,550
Sand and gravel	10,535
Slate	1,352,541
Stone	6,993,765
Other products, including clay, ocher, talc, and whetstones	118,555
Total	8,797,834

VIRGINIA.

Arsenic	[d]
Barytes	$27,838
Clay products	1,994,578
Coal	3,777,325
Coke	2,869,452
Ammonium sulphate	[f]
Coal tar	21,152
Gas, illuminating	485,368
Gas coke	116,879
Copper	[d]
Gold (mines report)	4,982
Iron, pig	[g] 7,540,000
Lead	[d]
Lime	396,434

VIRGINIA—Continued.

Manganese ores	$35,209
Marl	[h]
Millstones	8,186
Mineral waters	549,102
Pyrite	426,008
Sand and gravel	154,580
Silver (mines report)	107
Slate	146,786
Stone	667,050
Zinc	[d]
Other products, including asbestos, cement, gypsum, iron ores, metallic paint, ocher, pottery, salt, sand-lime brick, talc, and titanium	2,530,950
Total	21,751,986

WASHINGTON.

Arsenic	[d]
Clay products	$1,175,032
Coal	5,141,258
Coke	251,717
Ammonium sulphate	[a]
Coal tar	32,268
Gas, illuminating	459,103
Gas coke	109,032
Copper	34,616
Gold (mines report)	405,078
Lead	5,035
Lime	160,985
Mineral waters	10,101
Silver (mines report)	75,727
Stone	919,110
Other products, including sand and gravel, sand-lime brick, and talc	11,482
Total	8,790,544

WEST VIRGINIA.

Bromine	[i]
Clay	$52,640
Clay products	2,018,795
Coal	32,341,790
Coke	6,548,205
Ammonium sulphate	[j] 86,530
Coal tar	50,542
Gas, illuminating	102,855
Gas coke	415,468
Glass sand	225,734
Iron, pig	[g] 5,250,000
Lime	255,337
Mineral waters	50,063

[a] Included under Colorado.
[b] Includes Idaho, North Dakota, and Wyoming.
[c] Included under Louisiana.
[d] Included under Miscellaneous.
[e] Included under New Hampshire.
[f] Included under West Virginia.
[g] Estimated.
[h] Included under New Jersey.
[i] Included under Michigan.
[j] Includes Virginia.

Value, by States, of mineral products of the United States, etc.—Continued.

WEST VIRGINIA—Continued.	
Natural gas	$10,075,804
Petroleum	16,132,631
Salt	74,063
Sand and gravel	86,161
Stone	842,627
Zinc	([a])
Other products, including cement, grindstones, iron ores	122,131
Total	74,731,376

WISCONSIN.	
Cement, natural	$63,737
Clay products	1,382,115
Coal products:	
Ammonium sulphate	121,464
Coal tar	94,305
Gas, illuminating	1,579,659
Gas coke	1,252,106
Iron ores	1,718,890
Pig	[b]5,510,000
Lead	([a])
Lime	726,071
Mineral waters	1,454,715
Sand and gravel	96,288
Stone	1,791,447
Zinc	([a])
Other products, including clay, coke, graphite, metallic paint, crystalline quartz, sand-lime brick	1,013,814
Total	16,804,611

WYOMING.	
Clay products	$34,556
Coal	7,336,951
Coal tar	([c])
Gas, illuminating	([c])
Gas coke	([c])
Copper	$392,232
Gold (mines report)	26,745
Gypsum	71,560
Lime	3,099
Petroleum	51,545
Silver (mines report)	2,208
Stone	59,431
Other products, including asbestos, clay, coke, grindstones, iron ores, mineral waters, natural gas, and sand and gravel	678,875
Total	8,657,202

MISCELLANEOUS PRODUCTS.

METALLIC.	
Antimony	$705,787
Arsenic	35,210
Copper	2,345,919
Iron, pig	8,460,000
Lead	9,890,640
Zinc	2,892,534
Total	24,330,090

NONMETALLIC.	
Alum and aluminum sulphate	$1,950,231
Fuller's earth	214,497
Gas, coke, tar, and ammonia	
Graphite, oilstones, and mineral waters	39,163
Precious stones	326,350
Salt and sand and gravel	19,416
Sand-lime brick and stone	73,450
White lead	15,838,649
Other lead paints	5,564,236
Total	24,025,992

[a] Included under Miscellaneous.
[b] Estimated.
[c] Included under Utah.

IRON ORES.

By John Birkinbine.

PRODUCTION.

The year 1905 stands preeminent in production of iron ore, with a total for the United States of 42,526,133 long tons, an advance of 6,971,998 long tons, or 20 per cent over the previous maximum output, 35,554,135 long tons in 1902. As compared with the record of the year 1904 (27,644,330 long tons) the increase of iron-ore output in 1905 was 54 per cent.

No other country has at any time approximated an annual production of iron ore such as that reported for the United States in 1905, the maxima of countries supplying iron ore as recorded to date being as follows:

Maxima productions of iron ore in principal countries.

United States (1905)	long tons..	42,526,133
German Empire, including Luxemburg (1904)[a]	metric tons..	22,047,393
United Kingdom (1882)	long tons..	18,031,957

This statement demonstrates that in 1905 the iron-ore product of the United States exceeded the combined output of the maxima years of the two countries which rank next to it in supplying iron ore. Contemporaneous data, if at hand, would show that in 1905 the production in the United States considerably exceeded the output of these two countries for the same year.

Considered as a source of metallic iron (for which most of the iron ore mined is applied), the mineral mined in the United States in 1905 probably produced more metal than the iron ore obtained in Germany, including Luxemburg, the United Kingdom, and Spain combined.

In the pages following will be found the data for the year 1905, from which the following is summarized:

Summary of iron-ore statistics for the United States for 1905.

Domestic iron ore produced:		
Red hematite	long tons..	37,540,198
Brown hematite	do....	2,546,662
Magnetite	do....	2,417,274
Carbonate	do....	21,999
Total	do....	42,526,133
Domestic iron ore exported	do....	208,017
Foreign iron ore imported	do....	845,651
Zinc residuum produced	do....	90,289
Concentrated iron ore produced	do....	755,677
Stocks of iron ore at mines, December 31, 1905	do....	3,812,281
Stocks of iron ore at lower lake ports, December 1, 1905	do....	6,758,511
Production of mines in the Lake Superior region	do....	33,325,018

[a] Advance but unofficial figures for 1905 give 23,444,073 metric tons.

The rapid development of the iron-ore industry, as indicated by the quantities of iron ore mined and of pig iron or its equivalent manufactured during the seventeen years for which statistics have been collected by the United States Geological Survey, is set forth in the following table:

Production of iron ore and pig iron in the United States, 1889–1905.

[Long tons.]

Year.	Iron ore mined.	Pig iron produced.[a]	Year.	Iron ore mined.	Pig iron produced.[a]
1889	14,518,041	7,603,642	1898	19,433,716	11,773,934
1890	16,036,043	9,202,703	1899	24,683,173	13,620,703
1891	14,591,178	8,279,870	1900	27,553,161	13,789,242
1892	16,296,666	9,157,000	1901	28,887,479	15,878,354
1893	11,587,629	7,124,502	1902	35,554,135	17,821,307
1894	11,879,679	6,657,388	1903	35,019,308	18,009,252
1895	15,957,614	9,446,308	1904	27,644,330	16,497,033
1896	16,005,449	8,623,127	1905	42,526,133	22,992,380
1897	17,518,046	9,652,680			

[a] From annual reports of the American Iron and Steel Association.

The apparent consumption of iron ore in 1905 is approximated by adding to the output of the various mines the foreign ore imported, and to this the amount of other materials used as ore, and equating the stocks at the beginning and the close of each year. Such approximations for consecutive years appear below:

Apparent consumption of iron ore for all purposes, 1889–1905.

[Long tons.]

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.
1889	14,518,041	2,256,973	853,573	....	2,607,106	43,648	14,366,562
1890	16,036,043	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
1905	42,526,133	3,812,281	845,651	208,017	6,758,511	90,289	43,113,594

While these figures show a close relation between the iron-ore output and the apparent consumption, there will be noted a variation, which is largely influenced by the stock carried at the mines and at the receiving docks on Lake Erie, where Lake Superior iron ores are stored.

Other items are, however, necessary to form a correct comparison, among these being the stocks of iron ores on hand at blast furnaces, mill cinder, scrap, roll scale, and other materials charged into blast furnaces, the quantity of iron ore used in open-hearth furnaces, used as a flux in silver smelters, in the manufacture of paint, etc.

The statement for 1905 shows also that, taking as a basis the domestic ore produced, the stocks of ores at the mines at the close of the year represented 9 per cent, the imports 2 per cent, the exports 0.5 per cent, and the stocks at lower lake ports December 1, 1905, 16 per cent of the quantity of domestic iron ore produced during the year 1905.

PRODUCTION OF IRON ORES BY STATES AND VARIETIES.

Twenty-seven States and Territories contributed to the iron-ore supply in 1905.

The classification of iron ores adopted in former reports is 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 character of the mineral obtained in 1905 was, approximately, 88 per cent red hematite, 6 per cent brown hematite, and 6 per cent magnetite, the carbonate ore representing only about one-twentieth of 1 per cent.

The quantity of red hematite mined in 1905 was 37,540,198 long tons, an increase of 13,700,721 long tons, or 57 per cent over the 1904 production of 23,839,477 long tons. Over one-half of this total was mined in Minnesota, the State ranking next in production being Michigan, then Alabama, Wisconsin, etc.

The output of brown hematite in 1905 was 2,546,662 long tons, an increase of 399,867 long tons, or 19 per cent, over the 1904 product of 2,146,795 long tons. Alabama was the principal contributor of this class of ore, followed by Virginia and West Virginia, Tennessee, etc.

The magnetite variety showed a decided advance in 1905, reaching a total of 2,417,274 long tons, an increase of 778,428 long tons, or over 47 per cent, over the 1904 output of 1,638,846 tons. New York was the principal contributor of this class of ore, followed by Pennsylvania, New Jersey, etc.

The production of carbonate ore in Ohio and Maryland in 1905 was 21,999 long tons, as against 19,212 tons in 1904.

The tonnage of each of the above-indicated classes in the different States is set forth in the following table:

Production of iron ore in the United States in 1905, by States and varieties.

[Long tons.]

State.	Red hematite.	Brown hematite.	Magnetite.	Carbonate.	Total.
Minnesota	21,735,182				21,735,182
Michigan	10,885,902				10,885,902
Alabama	2,974,413	781,561	26,857		3,782,831
New York	80,020	9,266	1,050,651		1,139,937
Wisconsin	842,976	16,307			859,283
Pennsylvania	4,425	166,435	637,857		808,717
Virginia and West Virginia	35,357	716,170	518		752,045
Tennessee	272,996	461,774			734,770
Montana, Nevada, New Mexico, Texas, Utah, and Wyoming	557,619	38,521	118,838		714,978
New Jersey			526,271		526,271
Georgia and North Carolina	45,408	155,434	56,282		257,124
Colorado	2,154	131,317			133,471
Missouri	78,746	34,266			113,012
Connecticut and Massachusetts		25,931			25,931
Kentucky and Iowa	25,000	100			25,100
Ohio				19,989	19,989
Maryland		6,259		2,010	8,269
Arkansas		3,321			3,321
Total	37,540,198	2,546,662	2,417,274	21,999	42,526,133

The changes in the relative quantities of ores as classified are emphasized in the following table:

Production of iron ores in the United States, by varieties, 1889–1905.

[Long tons; maxima in italics.]

Year.	Red hematite.	Brown hematite.	Magnetite.	Carbonate.	Total.
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
1905	*37,540,198*	2,546,662	2,417,274	21,999	*42,526,133*
Total	302,791,487	42,024,844	28,845,095	2,030,354	375,691,780
Percentage of totals for 17 years	81	11	7.5	0.5	
Percentage of total for 1905	88	6	6		

It will be noted that the outputs of brown hematite, magnetite, and carbonate ores in 1905 have been exceeded in former years, but that of red hematite is the maximum.

The production of concentrated ore in the United States in the year 1905 was 755,677 long tons, most of which was magnetically separated. There were also made 90,289 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.

Investigation of the iron sands which abound along the Pacific coast and of other lean or impure magnetic iron ores has been continued by Dr. David T. Day, of the United States Geological Survey, at Portland, Oreg., an appropriation having been made by Congress. In addition to a determination of the quantity of various minerals and metals in the concentrates from black sands, some of the iron ore thus obtained has been treated by electric smelting, and satisfactory results have been achieved. The predominance of chromium and titanium alloys of iron does not encourage the use of the concentrates obtained from iron sands in blast-furnace practice as now followed, but the product of electric smelting is applicable to special uses. As this method of treatment is improved, and the generation of electricity reduced in cost, a liberal consumption of the black sands may be expected.

In concentrating these sands to obtain the more precious metals and minerals, the portion in which iron predominates is practically a by-product, and when the treatment reaches such proportions as to produce large quantities of this by-product, the iron metallurgist may be expected to develop means for overcoming the disadvantages which are now considered as limiting the usefulness of ilmenite, chromite, and other iron alloys. The possibility of eliminating the ilmenite and chromite by magnetic concentration, as now practiced in the Adirondack region, is expected to add to the commercial value of black sands.

Comprehensive experiments carried on by the Canadian Government have added materially to our knowledge of electrical smelting, the results being published in an official report.[a]

Late developments in the application of rotary furnaces, similar to those employed in the manufacture of cement, to the treatment of fine iron ores, principally pyrites, clinker, blue billy, and flue dust from blast furnaces, are to desulphurize them and to form the fine material into nodules of such form and texture as will permit of transportation to blast furnaces, and of delivery of this material to the smelting zones. This process makes available ore which, either because of its sulphur contents or its fine state of comminution, was considered undesirable, and also reduces the loss of ore due to modern methods of charging blast furnaces and of operating them with high blast pressure.

LAKE SUPERIOR REGION.

The Lake Superior region, which includes five mineral ranges in States bordering upon the great inland sea, continues, by augmented annual outputs, to outrank all other known deposits in supplying iron ores. In the year 1905 its production of 33,325,018 long tons exceeded its former maximum of 26,977,404 long tons in 1902 by 24 per cent, and the record of 1904 by 65 per cent.

The mines which compose the five ranges of the Lake Superior region contributed more than three-fourths of the total iron ore mined in the United States in 1905,

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[a] Report of the Commission appointed to investigate the different electro-thermic processes for the smelting of iron ores and the making of steel in operation in Europe: Department of Interior, Canada, 1904; see also an address by Dr. Eugene Hamel on the "Electric smelting of magnetite ores" before the Canadian Club, Toronto, March 12, 1906.

and to date this region has supplied an aggregate of over 300,000,000 long tons of iron ore. Of this quantity the Marquette Range in Michigan, which has been producing since 1854, has shipped 77,000,000 long tons; the Menominee Range, in Michigan and Wisconsin, has, since its opening in 1877, furnished 53,500,000 long tons; the Gogebic Range, in Michigan and Wisconsin, opened in 1884, has shipped 47,000,000 long tons; the Vermilion Range in Minnesota, opened also in 1884, has supplied 23,500,000 long tons; but the phenomenal shipments have been from the Mesabi Range in Minnesota, which since 1892 have reached a total of 99,000,000 long tons, or nearly one-third of the ore obtained from the Lake Superior region.

This summary refers to the shipment of ore, as the records of production have only been collected since the year 1889. The production by ranges from that year to 1905, inclusive, is as follows:

Production of Lake Superior iron ores, by ranges, 1889–1905.

[Long tons; maxima in italics.]

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

Range.	1895.	1896.	1897.	1898.	1899.	1900.
Marquette	1,982,080	2,418,846	2,673,785	2,987,930	3,634,596	*3,945,068*
Menominee	1,794,970	1,763,235	1,767,220	2,275,664	3,281,422	3,680,738
Gogebic	2,625,475	2,100,398	2,163,088	2,552,205	2,725,648	3,104,033
Vermilion	1,027,103	1,200,907	1,381,278	1,125,538	1,643,984	1,675,949
Mesabi	2,839,350	3,082,973	4,220,151	4,837,971	6,517,305	8,158,450
Total	10,268,978	10,566,359	12,205,522	13,779,308	17,802,955	20,564,238

Range.	1901.	1902.	1903.	1904.	1905.
Marquette	3,597,089	3,734,712	3,686,214	2,465,448	3,772,645
Menominee	3,697,408	4,421,250	4,093,320	2,871,130	*4,472,630*
Gogebic	3,041,869	*3,683,792*	3,422,341	2,132,898	3,344,551
Vermilion	1,805,996	*2,057,532*	1,918,584	1,056,430	1,578,626
Mesabi	9,303,541	13,080,118	13,452,812	11,672,405	*20,156,566*
Total	21,445,903	26,977,404	26,573,271	20,198,311	*33,325,018*

This table treats of the five ranges located in the Lake Superior region in the United States, omitting the Michipicoten Range in Ontario, Canada, opened in the year 1900, which has mined, to the close of the year 1905, the total of 1,090,939 long tons, of which 179,900 long tons were mined in 1905. Most of this ore has been supplied to furnaces in the United States.

The maximum annual production of the Lake Superior region was in the year 1905, when 33,325,018 long tons were mined, or 78 per cent of the total for the whole of the United States. The Mesabi Range was the largest contributor in the Lake Superior region, with 20,156,566 long tons, or 60.5 per cent of the total; the Menominee Range was next, with 4,472,630 long tons, or 13.4 per cent, then the Marquette

Range, with 3,772,645 long tons, or 11.4 per cent; the Gogebic Range, with 3,344,551 long tons, or 10 per cent; and the Vermillion Range, with 1,578,626 tons, or 4.7 per cent.

The total production for the Lake Superior region for the past decade, 1896–1905, inclusive, was 203,438,289 long tons, or practically two-thirds of the entire quantity obtained from this district since its opening in 1854.

Pig-iron production in recent years has not increased over the outputs of the years of the decade preceding 1900 in the same proportion in which recent lake-ore outputs have increased over the outputs of the nineties. Eight or ten years ago the average iron content of lake ores was 59 to 60 units of metallic iron. The average iron content of the 34,000,000 tons shipped in 1905 is between 54 and 55 per cent. In other words, about 3,000,000 tons of this year's shipments represent the diminution in iron content, as compared with ten years ago. In the old days the furnacemen insisted on having high-grade ores, and in the sharp competition of those times mines were robbed of the richest of their ores by wasteful mining methods, the less desirable ores being left in their places. Now that furnacemen are their own miners the ores are taken out as they come, the policy being to remove the ore in the most orderly and economical way, looking to the future as well as to the present. The average shipment of to-day would not have been accepted by the merchant furnaceman of ten or twelve years ago as high grade.

The days of skimming the cream of the lake-ore deposits are over, and each year's installment is brought down with a thorough realization that a great cavity that will never be filled has been left in the greatest and richest iron hills in the world.

The cargo analyses of most of these ores, as shipped in 1905, will be found in the following table, supplied through the courtesy of the Lake Superior Iron Ore Association:

Complete average cargo analyses of Lake Superior iron ores of the season 1905.

[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.
Ashland	59.90	0 045	7.20	0.300	3.03	0.370	0.320	0.010	2.75	....
	53.4907	.04018	6.4296	.2679	2.7058	.3304	.2857	.00893	2.4557	10.70
Anvil	62.35	.049	4.90	80	1.13	.35	.20	.04	2.80	....
	54 24	.0426	4.26	.696	.98	.30	.17	.0348	2.436	13.00
Atlantic	64.1115	.0419	3.8510	.3572	....	....	....	....	....	....
	56.8046	.0371	3.4121	.3165	....	....	....	....	....	11.3971
Aurora	61.6210	.0385	5.2060	.3959	....	....	....	....	....	....
	54.5689	.0341	4.6102	.3506	....	....	....	....	....	11.4443
Bonnie	50.45	.038	11.96	6 01	2.24	.11	.19	.013	4.93	....
	44.66	.0336	10.588	5.32	1.98	.097	.168	.0115	4.36	11.47
Brotherton	60.37	.026	10.78	.45	.96	.26	.09	.007	.98	....
	54.6107	0235	9.7515	.4070	.8684	.2351	.081	.0063	.8865	9.54
Cary Empire	58.08	.066	7.52	2.37	.91	11	.19	.007	5.11	....
	52 1848	.0593	6.7567	2.1294	.8176	.0988	.1707	.00628	4.5913	10.15
Eureka[a]	61.00	060	....	....	....	....	....	....	....	....
	54.90	.054	....	....	....	....	....	....	....	10.00
Hennepin	57.35	.057	11.47	....	....	....	....	....	....	....
	51.0816	.0507	10 2163	....	....	....	....	....	....	10.93

[a] Expected analysis for the season of 1906.

Complete average cargo analyses of Lake Superior iron ores of the season 1905—Continued.

GOGEBIC RANGE—Continued.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
Hildreth [a]	56.00	0.080	11.95	0.59	2.45	0.39	0.46	0 009	3.71	....
	48.72	.0696	10.3965	.5133	2.1315	.3393	.4002	.0078	3.2277	13.00
Lawrence	62.33	.057	4.88	.57	1.05	.08	.07	.009	3.76	....
	56.0097	.0512	4.3852	.5122	.9435	.0719	.0629	.0081	3.3787	10.14
Melrose	61.20	.045	5.60	.65	1.25	.30	.07	.032	4.15	....
	54.119	.0398	4.95	.57	1.105	.265	.062	.028	3.67	11.57
Mikado	58.00	.187	11.80	.41	.85	.74	.36	.008	2.39	....
	50.46	.16269	10.266	.3567	.7395	.6438	.3132	.00696	2.0793	13.00
Montreal	62.83	.045	4.79	.30	1.51	.12	.18	.010	3.38	....
	56.3711	.0404	4.2976	.2692	1.3548	.1077	.1615	.0090	3.0325	10.28
Montrose [a]	62.00	.080	4.34	.65	1.15	.32	.35	.010	4.37	....
	55.18	.071	3.86	.578	1.02	.28	.31	.0089	3.889	11.00
New Era	57.95	.0458	11.11	.58	1.52	.19	.24	.007	3.19	....
	52.155	.0412	10.00	.52	1.368	.17	.216	.006	2.87	10.00
New Era No 2	56.82	.056	13.86	.55	1.00	.14	.10	.004	2.87	....
	51.615	.0509	12.59	.50	.908	.127	.09	.0036	2.607	9.16
Newport	56.00	.041	5.05	5.81	1.25	.35	.07	.036	4.90	....
	50.058	.0366	4.51	5.19	1.117	.31	.06	.032	4.38	10.61
Norden	62.5040	.0772	3.8826	.7611	....	....	....	....	....	....
	54.1957	.0669	3.3665	.6599	....	....	....	....	....	13.2925
Norrie	62.8373	.0388	4.2298	.4314	....	....	....	....	....	....
	55.7286	.0344	3.7513	.3826	....	....	....	....	....	11.3128
Ottawa	57.90	.061	6.13	3.05	1.43	.06	.34	.006	4.97	....
	51.9942	.0548	5.5047	2.7389	1.2841	.0539	.3053	.0054	4.4630	10.20
Ottawa Manganese	53.44	.064	6.71	6.25	1.49	.15	.20	.006	5.27	....
	48.0960	.0576	6.0390	5.6250	1.3410	.1350	.1800	.0054	4.7430	10.00
Rand	61.2589	.0450	3.4305	2.7246	....	....	....	....	....	....
	53.2960	.0392	2.9846	2.3704	....	....	....	....	....	12.9988
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	60.80	.030	10.40	.35	1.09	.12	.12	.004	.73	....
	55.2185	.0272	9.4452	.3178	.9899	.1089	.1089	.0036	.6629	9.18
Taylor	58.40	.050	8.10	.250	3.79	.280	.100	.012	3.45	....
	52.0636	.04457	7.2212	.2228	3.3788	.2496	.0891	.0107	3.0756	10.85
Tilden	63.5644	.0561	3.2333	.7129	....	....	....	....	....	....
	55.0855	.0486	2.8020	.6178	....	....	....	....	....	13.3390
Wisconsin	49.65	.062	....	7.13	....	....	....	....	....	....
	44.61	.0557	....	6.4063	....	....	....	....	....	10.15
Windsor Bessemer	60.71	.053	7.61	.44	1.22	.23	.24	.008	3.22	....
	54.0319	.04717	6.7729	.3916	1.0858	.2047	.2136	.00712	2.8658	11.00
Yale	62.90	.035	4.65	.37	.84	.65	.21	.033	2.65	....
	55.5281	.0309	4.1050	.3266	.7416	.5738	.1854	.0291	2.3394	11.72
Yale No. 2	62.51	.136	....	....	....	....	....	....	....	....
	54.8027	.1192	....	....	....	....	....	....	....	12.335

BARABOO RANGE.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
Illinois	53.85	0.050	18.19	0.19	1.37	0.38	0.18	Trace.	2.00	....
	47.33	.044	15.95	.17	1.20	.33	.16	Trace.	1.75	12.13

[a] Expected analysis for the season of 1906.

Complete average cargo analyses of Lake Superior iron ores of the season 1905—Continued.

MARQUETTE RANGE.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
Abbotsford	62.0224	0.0428	8.4552							
	61.1938	.0422	8.3422							1.3359
Alford	63.3030	.0528	5.7447							
	56.2126	.0469	5.1008							11.2078
Angeline, hard	66.96	.014	1.78							
	63.1164	.01319	1.6778							5.74
Angeline, hematite	65.15	.044	3.04							
	58.4851	.03949	2.7290							10.23
Angeline, South	63.17	.114	4.30							
	56.4550	.10188	3.8429							10.63
Averhart	60.7990	.0538	7.4292							
	55.1845	.0488	6.7432							9.2345
Beaufort	49.6761									
	45.7686									7.866
Bedford	59.6425	.1514	8.0296							
	51.5612	.1309	6.9416							13.5496
Beresford lump	62.7994	.1121	5.3791							
	62.2797	.1112	5.3346							.8276
Beresford crushed	64.1458	.0712	4.4623							
	63.5043	.0705	4.4177							1.0000
Beresford No. 2	59.3161	.1306	8.0900							
	58.3771	.1285	7.9619							1.5830
Bernhart	59.2625	.0723	8.8138							
	53.8776	.0657	8.0129							9.0866
Bessie	51.2947	.3963	14.9951							
	48.8328	.3773	14.2754							4.7995
Buffalo-Cameo	60.0173	.0974	6.8919							
	51.0246	.0828	5.8593							14.9835
Cambria	57.54	.0612								
	52.94	.0563								8.00
Cambridge	59.50	.696	5.50	0.520	1.28	2.82	0.650	0.011	0.70	
	51.1759	.5986	4.7305	.4472	1.1009	2.4255	.5590	.00946	.6020	13.99
Castleford	54.2334	.0926	17.0817							
	53.5328	.0914	16.8610							1.2919
Castleford Bessemer	55.3690	.0451	17.5610							
	54.5134	.0444	17.2896							1.5452
Champion No. 1 lump	61.8231	.0919	6.7608							
	61.5238	.0915	6.7281							.4841
Champion No. 1 crushed	63.9000	.0540	5.0500							
	63.0885	.0533	4.9859							1.2700
Chatford	53.8285	.1615	16.7669							
	48.6947	.1461	15.1678							9.5373
Cliffs Shaft, crushed	62.20	.102	4.45	.300	2.25	.950	.810	.018	.50	
	61.6713	.10113	4.4122	.2974	2.2308	.9419	.8031	.01785	.4957	.85
Cliffs Shaft, lump	63.07	.112	4.25	.220	2.30	.740	.720	.019	.85	
	62.8303	.11157	4.2339	.2191	2.2912	.7372	.7173	.0189	.8468	.38
Clinton	62.48	.285	5.10	.300	2.64	.720	.100	.012	1.40	
	54.6700	.24937	4.4625	.2625	2.3100	.630	.0875	.0105	1.225	12.50
Empire[a]	45.00	.057	30.00	.11	1.14	.35	.18	.018	1.95	
	43.6500	.0553	29.1000	.1067	1.1058	.3395	.1746	.0175	1.8915	3.00
Foxdale	53.13	.059	21.13							
	52.1335	.0579	20.7349							1.87

[a] Expected analysis for the season of 1906.

Complete average cargo analyses of Lake Superior iron ores of the season 1905—Continued.

MARQUETTE RANGE—Continued.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
Hartford lump	60.4751	0.0623	7.8753	....	....	....	....	....	....	....
	56.4869	.0582	7.3559	....	....	....	....	....	....	6.5947
Imperial [a]	52.44	.256	13.49	0.198	1.20	1.37	1.39	0.011	7.38	....
	47.0282	.2296	12.0978	.1775	1.0762	1.2286	1.2465	.00986	6.6183	10.32
Jackson lump Scotch	53.20	.040	20.50	.180	1.73	.300	.130	.021	.70	....
	52.6414	.03958	20.2847	.1781	1.7118	.2969	.1283	.0207	.6927	1.05
Jackson, South	43.90	.080	27.40	2.72	1.55	.300	.110	.017	2.90	....
	40.2124	.07328	25.0984	2.4915	1.4198	.2748	.1007	.01557	2.6564	8.40
Lake	59.40	.103	6.50	.550	2.80	.490	.570	.009	3.20	....
	52.2740	.09064	5.7200	.4840	2.4640	.4312	.5016	.00792	2.8160	12.00
Lake Bessemer	62.00	.042	6.90	.310	1.46	.280	.110	.008	1.70	....
	55.18	.03738	6.141	.2759	1.2994	.2492	.0979	.00712	1.513	11.00
Lake Bessemer Silica	45.00	.040	31.25	.280	1.05	.200	.280	.009	2.00	....
	40.41	.0359	28.0625	.2514	.9429	.1796	.2514	.00808	1.796	10.20
Lillie	59.27	.0858	....	....	....	....	....	....	....	....
	51.86	.0750	....	....	....	....	....	....	....	12.50
Mary [a]	60.00	.100	6.00	.27	3.05	.56	1.18	.012	2.39	....
	52.80	.088	5.28	.238	2.68	.49	1.038	.0106	2.10	12.00
Negaunee Bessemer	60.20	.056	6.80	.280	2.42	1.26	.210	.010	1.85	....
	53.0964	.04939	5.9976	.2469	2.1344	1.1113	.1852	.00882	1.6317	11.80
Negaunee non-Bessemer	59.00	.086	7.85	.250	2.66	1.15	.100	.012	2.00	....
	51.6250	.07525	6.8687	.2188	2.3275	1.0062	.0875	.0105	1.750	12.50
Norfolk, Bessemer crushed	52.8612	.0601	20.0998	....	....	....	....	....	....	....
	52.3853	.0596	19.9189	....	....	....	....	....	....	.9002
Norfolk non-Bessemer, crushed	54.6650	.1408	13.4724	....	....	....	....	....	....	....
	54.0611	.1392	13.3236	....	....	....	....	....	....	1.1047
Princeton	58.80	.158	8.00	.520	1.23	1.10	.630	.010	.95	....
	49.9682	.13426	6.7984	.4419	1.0452	.9348	.5354	.00849	.8073	15.02
Republic, crushed	63.35	.048	6.84	.04	1.00	.55	.35	.003	.14	....
	62.98	.0477	6.80	.0398	.99	.547	.348	.003	.139	.58
Republic specular, lump.	66.75	.087	3.20	.07	1.24	.47	.11	.022	None.	....
	66.46	.0866	3.186	.0697	1.23	.468	.109	.0219	None.	.43
Richmond [a]	43.75	.050	33.38	.10	1.00	.21	.27	.005	1.88	....
	42.21	.048	32.205	.096	.96	.20	.26	.0048	1.81	3.52
Rolling Mill	42.81	.060	32.67	....	....	....	....	....	....	....
	39.4836	.05533	30.1315	....	....	....	....	....	....	7.77
Rose	59.59	.145	....	....	....	....	....	....	....	....
	53.63	.130	....	....	....	....	....	....	....	10.00
Salisbury	60.00	.114	6.70	.340	2.42	.510	.260	.011	2.25	....
	52.440	.09963	5.8558	.2971	2.1150	.4457	.2272	.00961	1.9665	12.60
Salisbury No. 2	50.80	.069	18.85	.410	2.02	.350	.290	.013	4.15	....
	45.7454	.05943	16.9744	.3692	1.981	.3151	.2611	.01170	3.7370	9.95
Scotch	62.10	.134	6.05	.150	2.70	.500	.700	.015	.50	....
	61.6094	.1329	6.0022	.1488	2.6787	.4961	.6945	.01488	.4961	.79
Sheffield	64.12	.035	5.13	....	....	....	....	....	....	....
	61.2025	.03340	4.8965	....	....	....	....	....	....	4.55
Tilden Silica	41.70	.045	37.10	.370	.69	.300	.130	.010	1.20	....
	41.1412	.04440	36.603	.3650	.6808	.2960	.1283	.0099	1.1839	1.34
Volunteer	56.0540	.1091	13.3602	....	....	....	....	....	....	....
	55.6863	.1084	13.2785	....	....	....	....	....	....	.6559

[a] Expected analysis for the season of 1906.

Complete average cargo analyses of Lake Superior iron ores of the season 1905—Continued.

MENOMINEE RANGE.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
Ajax	51.7257	0.0595	15.9563	0.4827						
	48.7194	.0560	15.0289	.4546						5.8120
Baltic	57.04	.574	5.06	.19	2.87	1.65	1.43	0.032	5.91	
	51.9064	.52234	4.6046	.1729	2.6117	1.5015	1.3013	.02912	5.3781	9.00
Bangor	59.4530	.2898	7.4837	.2644						
	53.6951	.2617	6.7589	.2388						9.6848
Barton	57.3194	.6230	4.5505	.2280						
	51.1546	.5560	4.0611	.2035						10.7552
Beta	57.00	.326	9.57	.12	1.16	.27	.16	.015	6.73	
	52.44	.29992	8.8044	.1104	1.0672	.2484	.1472	.0138	6.1916	8.00
Bristol	55.27	.685	5.38	.82	2.70	2.61	1.72	.017	5.84	
	50.4947	.6258	4.9152	.7492	2.4667	2.3845	1.5714	.0155	5.3354	8.64
Cadiz	50.7964	.0534	20.8760	.1398						
	47.7018	.0501	19.6042	.1313						6.0922
Calumet[a]	39.62	.020	39.08	.16	1.92	.13	.64	.010	.09	
	37.9361	.01915	37.4191	.1532	1.8384	.1244	.6128	.00957	.0862	4.25
Chapin	58.6636	.0641	6.6963	.4033						
	55.0531	.0602	6.2842	.3785						6.1546
Clearfield	59.2121	.1345	4.4485	.1841						
	52.1732	.1185	3.9197	.1622						11.8876
Clifford	41.10	.013	38.28	.18	.93	.71	.75	.023	.50	
	40.1300	.0127	37.3766	.1758	.9081	.6932	.7323	.0225	.4882	2.36
Condor	54.5400	.2800	15.0300	.1600						
	49.7950	.2556	13.7224	.1461						8.7000
Davidson	55.59	.388	9.28	.38	2.52	1.18	1.71	.169	3.82	
	50.5035	.3525	8.4309	.3452	2.2894	1.0720	1.5535	.1535	3.4705	9.15
Davy[a]	40.385	.029	35.89	.132	1.028	1.01	1.313	.020	2.04	
	39.8769	.02863	35.4385	.1303	1.0150	.9972	1.296	.0197	2.0143	1.258
Dober Lump	60.1317	.4853	2.9099	.1836						
	58.3762	.4711	2.8249	.1782						2.9194
Florence	54.90	.380	6.74	.13	3.95	1.02	1.51	.100	5.99	
	49.717	.344	6.10	.118	3.577	.92	1.367	.0906	5.42	9.44
Gamma	50.00	.323	20.28	.09	1.18	.29	.16	.021	5.90	
	46.25	.29877	18.759	.0832	1.0915	.2682	.1480	.01942	5.4575	7.50
Granada	59.1300	.0606	8.1678	.1529						
	54.8332	.0562	7.5743	.1418						7.2667
Hemlock	54.48	.231	6.70	.33	2.78	3.56	3.05	.010	4.97	
	52.437	.2223	6.4487	.3176	2.6757	3.4265	2.9356	.0096	4.7836	3.75
Hiawatha	52.7053									
	48.7682									7.47
Iron Ridge	40.88	1.20	6.00		3.02	6.76	3.09			
	37.7281	1.1074	5.5374		2.7871	6.2388	2.8517			7.71
Manganate	53.08	.605	5.25	3.05	2.55	1.95	2.10	.023	6.90	
	48.5098	.5529	4.7980	2.7874	2.3304	1.7821	1.9192	.0210	6.3059	8.61
Manganate No. 2	50.28	.521	4.03	4.91	2.62	1.87	2.68	.048	8.76	
	47.1476	.4885	3.7789	4.6041	2.4568	1.7535	2.5130	.0450	8.2143	6.23
Mansfield Lump	59.2993	.1384	4.3147	.1851						
	52.6669	.1229	3.8321	.1644						11.1846
Marie	59.702	.017								
	54.4858	.0155								8.737
Michigan Lump	54.2005	.2335	3.6596	.2766						
	53.0409	.2285	3.5813	.2707						2.1394

[a] Expected analysis for the season of 1906.

Complete average cargo analyses of Lake Superior iron ores of the season 1905—Continued.

MENOMINEE RANGE—Continued.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
Michigan No. 1	55.8225	0.2815	5.4006	0.2299						
	51.5685	.2600	4.9890	.2124						7.6206
Pewabic	63.85	.009	5.45	.14	0.87	0.41	1.20	0.003	0.84	
Pewabic Genoa	39.72	.009	38.90	.06	1.44	.53	1.44	.013	1.07	
Russell	53.70	.056	11.36	.24	2.73	1.22	3.40	.018	4.25	
	49.646	.0518	10.50	.22	2.52	1.128	3.14	.0166	3.929	7.55
Toledo	49.16	.009	25.00	.12	1.35	.67	1.56	.004	1.28	
Vivian	40.00	.016	36.73	.09	1.43	1.24	1.31	.014	1.88	
	38.80	.01552	35.6281	.0873	1.3871	1.2028	1.2707	.01358	1.8236	3.00
Walpole	57.95	.117	8.33	.17	1.62	1.51	2.96	.008	2.40	
	53.8935	.10881	7.7469	.1581	1.5066	1.4043	2.7528	.00744	2.232	7.00
Waucedah	40.00	.015	39.88	.03	1.06	.37	.81	.009	.65	
	38.80	.01455	38.6836	.0291	1.0282	.3589	.7857	.00873	.6305	3.00
Youngs [a]	58.90	.375	6.25	.40	2.05	1.03	.80	.052	4.35	
	54.777	.348	5.812	.372	1.906	.9579	.744	.0483	3.955	7.00

MESABI RANGE.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
Agnew [a]	59.93	0.056	5.24	0.87	2.34	0.16	0.13		4.82	
	50.52	.046	4.41	.73	1.97	.14	.11		4.07	15.66
Ajax	59.10	.069	5.87	.42	1.91	.30	.32	0.008	6.41	
	52.008	.06072	5.1656	.3696	1.6808	.2640	.2816	.00704	5.6408	12.00
Albany	59.25	.082	4.25	.82	2.62	.20	.22	.008	6.69	
	52.14	.07216	3.74	.7216	2.3056	.176	.1936	.00704	5.8872	12.00
Alexander	60.55	.034	7.00	.68	1.88	.32	.10	.008	2.86	
	53.847	.030	6.225	.60	1.67	.28	.089	.007	2.54	11.07
Beaver	62.30	.089	3.16	.32	1.77	.24	.26	.009	4.90	
	54.637	.078	2.77	.28	1.55	.21	.228	.0079	4.297	12.30
Bessemer	60.69	.037								
	55.83	.034								8.00
Biwabik	62.22	.046	3.98	.42	1.34	.15	.11	.005	4.71	
	56.29	.04146	3.5879	.3786	1.2080	.1352	.0991	.0045	4.2460	9.85
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	62.3745	.0418	3.0595	.7342						
	56.1434	.0376	2.7539	.6609						9.9898
Corsica [a]	57.00	.044	9.05	.98	1.27	.19	.18	.009	6.22	
	50.1600	.03872	7.9640	.8624	1.1176	.1672	.1584	.0079	5.4736	12.00
Crosby [a]	59.18	.033	11.52	.53	1.18	.14	.13	.005	1.85	
	52.9661	.02954	10.3104	.4743	1.0561	.1253	.1164	.0045	1.6557	10.50
Croxton	58.87	.057	6.38	.718	1.446	.22	.16	.010	6.04	
	52.98	.0513	5.742	.646	1.301	.198	.144	.009	5.436	10.00
Cyprus	60.55	.065	4.71	.58	1.48	.11	.17	.008	6.14	
	53.89	.05785	4.1919	.5162	1.3172	.0979	.1513	.00712	5.4646	11.00
Douglas	59.90	.038	8.29							
	54.4730	.03455	7.5389							9.06
Duluth	59.3499	.0600	5.2226							
	52.4197	.0530	4.6128							11.6768

[a] Expected analysis for the season of 1906.

Complete average cargo analyses of Lake Superior iron ores of the season 1905—Continued.

MESABI RANGE—Continued.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
Elba	62.00	0.036	5.18	0.66	0.80	0.12	0.27	0.007	4.07	....
	57.0400	.03312	4.7656	.6072	.7360	.1104	.2484	.0064	3.7441	8.00
Franklin[a]	60.00	.041	....	....	....	....	....	....	....	....
	56.17	.038	....	....	....	....	....	....	....	6.39
Grant	57.80	.079	6.91	....	....	....	....	....	....	....
	49.9854	.06831	5.9757	....	....	....	....	....	....	13.52
Group No. 1	61.9325	.0380	4.4360	.5510	....	....	....	....	....	....
	55.2619	.0339	3.9582	.4917	....	....	....	....	....	10.7707
Group No. 2	61.4786	.0466	4.5180	.4849	....	....	....	....	....	....
	53.8700	.0408	3.9589	.4249	....	....	....	....	....	12.3760
Group No. 2, special	63.8973	.0238	2.9541	.4130	....	....	....	....	....	....
	57.1977	.0213	2.6444	.3697	....	....	....	....	....	10.4850
Group No. 3	58.7688	.0731	5.7331	.7874	....	....	....	....	....	....
	50.7279	.0631	4.9487	.6797	....	....	....	....	....	13.6823
Group No. 3, High Mang	53.9416	.0583	6.4438	3.5426	....	....	....	....	....	....
	46.2522	.0500	5.5252	3.0376	....	....	....	....	....	14.2551
Group No. 4	57.6996	.0675	5.6195	.7997	....	....	....	....	....	....
	48.6140	.0569	4.7346	.6738	....	....	....	....	....	15.7463
Hanobe[a]	58.00	.063	10.12	.27	2.33	.16	.13	.007	3.96	....
	51.04	.055	8.906	.238	2.05	.14	.11	.006	3.48	12.00
Hawkins[a]	58.50	.045	9.54	.27	2.13	.19	.14	.008	3.95	....
	52.00	.040	8.48	.24	1.89	.169	.12	.007	3.51	11.11
Hector	59.10	.069	5.87	.42	1.91	.30	.32	.008	6.41	....
	52.008	.06072	5.1656	.3696	1.6808	.2640	.2816	.00704	5.6408	12.60
Higgins	60.9478	.0299	7.8616	.5924	1.3932	....	....	....	....	....
	56.3292	.0276	7.2659	.5475	1.2876	....	....	....	....	7.5779
Higgins (Basic)	60.4305	.0275	7.6362	1.3712	1.2729	....	....	....	....	....
	55.7173	.0254	7.0406	1.2643	1.1736	....	....	....	....	7.7993
Hobart[a]	59.00	.082	8.10	1.06	1.50	.22	.14	.010	3.75	....
	53.10	.0738	7.29	.954	1.35	.198	.126	.009	3.375	10.00
Holland	60.54	.038	7.57	.34	.96	.30	.08	.0111	3.00	....
	54.2591	.03405	6.7834	.3046	.86	.2688	.07168	.0094	2.688	10.38
Kinney	57.85	.086	5.12	1.25	2.53	.42	.45	.041	7.35	....
	50.138	.0745	4.437	1.08	2.19	.36	.39	.0355	6.37	13.33
La Belle	59.17	.046	8.93	.81	1.13	....	....	....	4.06	....
	53.41	.041	8.08	.73	1.02	....	....	....	3.66	9.78
La Rue[a]	60.00	.045	7.15	.32	.958	.16	.03	.012	2.17	....
	55.2000	.04140	6.5780	.2944	.8813	.1472	.0276	.0110	1.996	8.00
Laura[a]	61.15	.056	4.24	.62	1.82	.38	.62	.065	4.38	....
	54.42	.0498	3.77	.55	1.62	.338	.55	.0578	3.898	11.00
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	59.40	.076	3.45	.78	1.42	.25	.09	.007	8.53	....
	52.27	.0669	3.036	.686	1.25	.22	.079	.006	7.506	12.00
Lincoln	62.63	.024	6.91	....	....	....	....	....	....	....
	57.6008	.02207	6.3551	....	....	....	....	....	....	8.03
Longyear	55.27	.07	....	....	....	....	....	....	....	....
	47.9356	.0607	....	....	....	....	....	....	....	13.27
Mahoning	65.05	.046	1.95	.34	1.15	.19	.07	.016	3.22	....
	58.499	.041	1.75	.306	1.03	.17	.06	.014	2.896	10.07
Malta	61.87	.026	7.80	.25	.61	.15	.18	.011	2.42	....
	56.673	.02381	7.1448	.2290	.5587	.1374	.1648	.0101	2.2167	8.40

[a] Expected analysis for the season of 1906.

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Complete average cargo analyses of Lake Superior iron ores of the season 1905—Continued.

MESABI RANGE—Continued.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
Mayas Bessemer[a]	60.50	0.045								
	55.66	.04140								8.00
Mayas Mang.[a]	52.50	.045		8.00						
	48.300	.04140		7.36						8.00
Miller	60.21	.088	3.85	.82	1.91		0.08		6.12	
	52.675	.078	3.40	.71	1.68		.07		5.35	12.56
Minorca	61.00	.031	7.26	.59	1.19	0.11	.28	.006	3.05	
	55.9675	.02844	6.6610	.5413	1.0918	.1009	.2569	.0055	2.7983	8.25
Morrow[a]	60.00	.061	6.72	.64	1.39	.22	.16	.012	4.94	
	54.60	.05551	6.1152	.5824	1.2658	.202	.1456	.0109	4.4954	9.00
Mohawk[a]	58.80	.069	3.84	1.36	1.67	.19	.34	.007	7.89	
	52.92	.0621	3.456	1.224	1.5030	.171	.3060	.0063	7.101	10.00
Nassau[a]	57.50	.087	8.61	.85	1.80	.25	.15	.010	5.90	
	51.75	.0783	7.749	.765	1.62	.225	.135	.009	5.31	10.00
Pearce[a]	60.00	.050	6.50	.50	1.50	.14	.12	.045	3.50	
	54.00	.045	5.85	.45	1.35	.126	.108	.0405	3.15	10.00
Pettit	57.39	.0595								
	51.08	.0529								11.00
Pillsbury Mang	60.2061	.0324	3.4401	1.7946						
	52.9914	.0285	3.0279	1.5795						11.9834
Shenango[a]	62.00	.043	5.20	.94						
	55.80	.03870	4.6800	.8460						10.00
Shilling	60.23	.063	5.09	.41	1.51	.19	.17	.009	6.03	
	53.0686	.0555	4.4847	.3612	1.3304	.1674	.1497	.0079	5.4130	11.89
Sparta	60.00	.028								
	54.42	.02539								9.30
Stephens	59.3407	.0601	4.3703	.3757	3.0773					
	50.0864	.0507	3.6887	.3171	2.5974					15.5952
Syracuse[a]	59.00	.042								
	53.10	.03780								10.00
Troy	55.53	.034	9.02	.99	2.67	.19	.77	.146	6.28	
	48.8664	.02992	7.9376	.8712	2.3496	.1672	.6776	.12848	5.5264	12.00
Utica Bessemer[a]	62.60	.033	4.83	.56	1.44	.25	.19	.005	3.11	
	56.34	.0297	4.3470	.5040	1.2960	.2250	.1710	.0045	2.799	10.00
Victoria[a]	60.00	.055								
	55.20	.0506								8.00
Virginia	63.1260	.0620	3.5574	.4578	2.6485					
	55.0109	.0540	3.1001	.3989	2.3080					12.8554
Webb	54.815	.037	15.00	.67						
	48.785	.03293	13.3500	.5963						11.00
Wilpen[a]	60.00	.058	6.04	1.80						
	52.20	.05046	5.2548	1.5660						13.00
Yates[a]	60.80	.065	6.14	.58	1.84	.25	.26	.018	3.49	
	53.315	.057	5.38	.509	1.61	.219	.228	.0158	3.06	12.31

VERMILION RANGE.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
Chandler	63.6123	0.0443	5.0404	0.1312						
	60.0815	.0418	4.7606	.1239						5.5505
Jura	62.3120	.0654	4.3983	.1277						
	58.6277	.0615	4.1382	1201						5.9126

[a] Expected analysis for the season of 1906.

Complete average cargo analyses of Lake Superior iron ores of the season 1905—Continued.

VERMILION RANGE—Continued.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
Pilot	66.7534	0.0300	2.3087	0.1094	....	....	....	....	....	....
	64.8577	.0291	2.2431	.1063	....	....	....	....	....	2.8398
Pioneer	63.9249	.0351	4.6955	.1296	....	....	....	....	....	....
	60.2525	.0331	4.4257	.1222	....	....	....	....	....	5.7449
Red Lake	61.3167	.1230	8.2733	.1310	....	....	....	....	....	....
	60.4223	.1212	8.1526	.1291	....	....	....	....	....	1.4587
Savoy	64.7586	.0402	3.6931	.1259	....	....	....	....	....	....
	61.0711	.0379	3.4828	.1187	....	....	....	....	....	5.6943
Vermilion Lump	66.8405	.0944	2.8756	.1090	....	....	....	....	....	....
	66.4262	.0938	2.8578	.1083	....	....	....	....	....	.6199

MICHIPICOTEN RANGE.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
Helen	59.30	0.120	4.50	0.20	0.96	0.25	0.08	0.180	8.70	....
	55.84	.113	4.238	.188	.90	.235	.075	.1695	8.19	5.83

Exploration during 1905 was not confined to the Mesabi, but extended to the Vermilion, to the Menominee, and to parts of the Marquette and Gogebic ranges. Deep shaft sinking on the last-named range is opening ore deposits that give promise of maintaining the output of the district at a steady rate for many years. Drilling on parts of the great ore-bearing formations of the Menominee range is opening a few mines of importance and is giving hope for more. Though immense sums have been spent on the Vermilion in past years with the diamond drill, no large deposits have been found aside from the Soudan and Ely groups. Now a number of drills are at work elsewhere.

In what is known as the Austin, Swanzey, and Palmer districts of the Marquette Range explorations during the year have revealed immense bodies of highly siliceous low-grade ores that may become of great importance. Some are well within the Bessemer limit as to phosphorus, and others are high in that element.

Explorations in comparatively new districts have been confined chiefly to the Deerwood, or "Cuyuna," range, 100 miles west of Duluth. A few holes have been driven in good non-Bessemer ores, and a fair quantity of merchantable foundry grades has been opened. Other holes have shown seams of good ore, both iron and manganese, and many holes have shown great bodies of lean iron. The work of the year, though carried on with the aid of from 20 to 30 drills, has not settled the question of the future importance of the district as one from which any large ore supplies are to come. A few leases have been closed for mining on the Cuyuna Range, and one or two of these may be considered important. As yet little or no preparation for work has been carried on, unless the shaft sinking of Pickands, Mather & Co. be called such. At this property about 150 feet of non-Bessemer ore running about 53 per cent has been cut. At other parts of the district holes have been driven vertically 400 feet in ore too low to be considered in this generation. At other parts ore running from 55 to 60 per cent and for 60 or more feet in depth has been cut, while elsewhere, again, manganiferous ores of 56 per cent combined analysis are found.

The development of the Atikokan Range in western Ontario, a short distance north of the Minnesota line, was begun in 1905 and has been continued steadily. It is proposed that ore shall be taken from this region and shipped to iron masters in eastern

Canada. The ore is a magnetite, high in iron, low in phosphorus and moisture, and otherwise fairly desirable, though somewhat pyritiferous. It exists in large quantity and is easily mined. Steps have been taken during the year also for the development of the Moose Mountain region, north of Georgian Bay, in Canada, where there are large deposits of magnetite.

On the Mesabi range alone stripping contractors and mining companies have moved in 1905 above 6,000,000 cubic yards of overburden, one contracting firm alone removing more than 2,000,000 yards. On this range the evolution from underground to open pit has been general, and with accelerated speed. It is now no bar to stripping that a mine is covered by 100 feet of overburden of bowlders, hardpan, drift, or ledge. It is all carried off, providing the ore deposit is of sufficient thickness to make the subsequent mine operation economical. Many Mesabi mines which have been operated underground from the beginning are to be stripped; indeed, many have already been changed from one system to the other.

In addition to the 8 or 10 new mines of 1905, there will be at least as many more in 1906. One of the properties opened in the past year, shipping its first ore in June, 1905, has made the greatest record the world has ever seen, with a total for the year of more than 1,000,000 tons.

In this statement the Lake Superior region is treated as a whole. The records for the different States, portions of which are comprised in this region, are also given in the following summary, which treats of each State in order of its prominence as a producer of iron ore.

IRON-ORE INDUSTRY OF THE VARIOUS STATES DURING 1905.

Minnesota.—As in the year 1904, this State stands preeminent as a producer of iron ore, the 21,735,182 long tons mined in 1905 being slightly more than one-half of the total for the United States. All of this ore was of the red hematite variety, although some hydrated ores are known locally as "brown hematites." This is an increase over the 1904 production (12,728,835 long tons) of 9,006,347 long tons, or 71 per cent, being the maximum output for the State and a larger quantity than was mined in the whole of the United States in any one year prior to 1899. This is also larger than the output of the entire German Empire, including Luxemburg, in the year 1904, but it is probable that contemporaneous figures will show that the latter may slightly surpass the tonnage of this State in 1905.

All of the ore mined is obtained from what are known as the Mesabi and Vermilion ranges. The first-named range, while opened in 1892, has become the most important in the Lake Superior region, and in fact in the world, and is remarkable on account of the number of large mines, most of which are worked open cut by means of steam shovels. One mine in this range, the Iron Mountain, in 1905 contributed 2,500,570 long tons, a wonderful record, and it is probable that the ore obtained from this mine in 1905 produced more pig iron than was made in the whole of the United States prior to 1868. In the list of prominent iron-ore mines, which appears on another page, it will be noted that there are seven other mines on this range, which in 1905 produced over 1,000,000 tons, the aggregate of these seven operations approximating 9,000,000 tons.

On the Mesabi Range many of the mines are located on lands which are owned by the State, and on them mineral leases have been taken out, the lessee paying a fixed sum per ton of ore mined. In the year 1905 legal action was taken by the State of Minnesota to test the constitutionality of the law under which these leases were made, which action, if successful, would have had the effect of nullifying all of them. The grounds for such an attempt hinged on the word "land," and whether or not it applies to iron ore therein. The constitution of Minnesota distinctly states that "no public lands shall be sold except at public sale," and mineral leases have never been sold at public sale, except where there have been simultaneous applications for individual tracts. The law under which these leases have been taken was passed in 1889 and provided for the issuance of a mineral lease or subsequent fifty-year contract upon application of the first comer who paid the requisite fee, which is $25 in case of lease, $100 in case of contract. If the leasing of the State land for the purpose of taking away iron ore is a sale of the land, then it was claimed the constitution has been violated upon every lease taken.

The case tried concerned the mineral contract on a tract of 36 acres of land in the vicinity of Virginia, on Mesabi Range. The litigation was decided in the district court of Duluth in favor of lessee and the mining interests, the court making no distinction between the swamp and school lands owned by the Commonwealth. From this decision the attorney-general of Minnesota appealed. The opinion also held that there is nothing in the constitution of the State prohibiting Minnesota from leasing its mineral holdings. It is the claim of the attorney-general that a mineral lease is synonymous with the sale of iron ore in place as land, and the conclusion is advanced that as mineral leases have been privately issued the acts constitute a violation of the constitutional provision that the public domain be disposed of at public sale.

In the background of the legal strife are interesting statistics showing that under the mineral-lease law of 1889 the State has issued, up to 1905, 4,313 leases to swamp and school lands. The sale of these leases netted the State $109,628. The majority of these leases have proved worthless in so far as the development of mineral wealth on the properties involved is concerned; but on 643 contracts the State has received $178,300 in annual rentals, in addition to royalties on ore produced amounting to $542,282.

There is a prospect that the controversy will eventually reach the United States Supreme Court.

The enormous output from the Mesabi Range has raised the question of these deposits continuing to supply equal quantities of ore in future years, and has encouraged a careful review of the apparent ore reserves. In some instances the early exhaustion of certain deposits is indicated. In others, systematic bore holes and analyses have developed large quantities of iron ore of valuable quality, which may serve as supplies for a number of years. Explorations have also been carried into other territory, and these indicate that the iron-ore field of Minnesota covers a larger area than had been anticipated, and that, while the quantity or the quality of ore known to exist in the Mesabi may not be duplicated in the outlying region as now developed, there is sufficient known to encourage optimism in a reliance on the State of Minnesota as a source of iron-ore supply for many years.

The following data as to handling materials on the Mesabi Range are given in the Iron Age, March 15, 1906.

There is being erected on the Mesabi Range at a mine where there is considerable thickness of overburden, with a depth of 200 feet of ore, a permanent overhead machine for removing earth and for mining ore. Tracks with wide gauge, on either side of the ore body to be stripped, carry high traveling steel towers. The distance from one tower to the other across the proposed pit is 1,100 feet. Cables stretched between these support a clam-shell grab capable of lifting a load sufficient to fill a car. The towers are shifted along the tracks by electricity, and the grab is actuated in all its motions by the same force. It is expected that the force of the grab will pick up its load of overburden and later its load of ore and deposit it where desired along the line of cable. It is intended, of course, to break up the stripping and ore by powder, though it is supposed the grab is fully capable of doing its work without prior loosening of the material.

The steam shovel employed on the Mesabi Range is a machine of 65 to 75 tons, though some have been built weighing up to 105 tons. The dipper is from 1¾ to 3 and 4 yards capacity, and these machines will handle daily from the bed of ore to the car from 4,000 to 7,000 tons. A yard of ore is about 2 tons, of overburden not far from 1 ton. In stripping, fair average work will be from 1,500 to 2,000 yards every twenty hours' continuous work, though for occasional spurts and by picked men vying with each other far higher records have been made. With a shovel in ordinary practice there will be about three attendant locomotives and trains of dump cars, especially if the waste dump is some distance from the mine. The shovel and its train will require 45 men on day shift and 30 at night. In good work these numbers are somewhat reduced to, say, 70 men or even less.

A fair average for Mesabi Range work will be 28 to 30 yards per day per man. Some cost sheets of Mesabi stripping run as low as 19 cents per yard, but these do not include depreciation, which is very high, and it is safe to say that average Mesabi stripping will cost from 25 to 28 cents a yard. It is probable that the costs of 1905 were greater than this, for the year was exceptionally unfavorable.

There will be in the neighborhood of 125 of these "steam Finlanders," as the miners call them, in constant use on the Mesabi Range during 1906 stripping, mining, and loading stock piles. Were it not for the steam shovel in mining, it would be an impossibility for the Lake Superior region to gather enough labor to get out in a season the enormous tonnage taken from this district. The machine has become so much more effective than in earlier years and the cost of mining underground has advanced so rapidly, while really skilled miners capable of efficient underground work have become so hard to secure, that the proportion of stripping mines is growing very fast, and the limit of depth to which a mine can be stripped is far more than a few years ago. One foot of stripping to 2 feet of ore was an accepted theory a short time ago, but now these figures have been reversed, providing the ore is deep enough to make the outlay remunerative. More than 6,000,000 yards of dirt were moved off Mesabi mines in 1905 by six contracting firms and two mining companies.

Steam shovels are now being equipped with auxiliary engines for lighting and handling certain parts electrically, making them more self-contained and adding to their efficiency.

The Vermilion Range, which was the first developed in Minnesota continues as an important producer, having in 1905 supplied 1,578,626 long tons of iron ore—a smaller quantity than this range has contributed since 1898, with the exception of 1904.

Michigan.—This State, in which the first ore was mined in the Lake Superior region, showed activity during the year, contributing 10,885,902 long tons of iron ore, the largest quantity ever mined, except in the years 1902 and 1903, when it was slightly exceeded. This was an increase of 3,796,015 long tons, or 53 per cent, over the 1904 total of 7,089,887 long tons. All of the ore is classed as a red hematite, although, as mentioned in the case of Minnesota, some of it is hydrated, locally known as "brown hematite," and in addition some martite is secured with the red hematite ore.

This ore is obtained from three ranges known as the Marquette, Menominee, and the Gogebic. On all of these ranges exploitation has been carried on during the year, and important developments in the opening of new mines or in the rehabilitation of abandoned workings are announced.

Large quantities of iron ore are now shipped from this State which in its earlier history were not considered marketable owing to their comparatively low iron content.

Alabama.—In 1905 Alabama supplied 3,782,831 long tons of iron ore, of which 2,974,413 tons were red hematite, 781,561 tons brown hematite, and 26,857 tons magnetite, giving the State in these classes third, first, and sixth positions, respectively. The increase over the 1904 total of 3,699,881 tons was 82,950 tons, or 2 per cent.

The character of some of the ores of Alabama and their distribution are described in a report upon Brookwood quadrangle, prepared for the United States Geological Survey, by Ernest F. Burchard.[a] This locality is west of the Bessemer quadrangle, in which mining of the red hematite ore has assumed extensive proportions.

This report states that the red ore, or hematite, occurs in minable quantities to the east and northeast of the Brookwood quadrangle in the East Red Mountain Ridge and in West Red Mountain. The ore in regular stratified beds forms a part of the Rockwood formation, which is of Silurian age, and has been designated by the Alabama geological survey the Red Mountain or Clinton. The formation is variable in thickness in the quadrangle, but averages about 350 feet. The ore occurs near the middle of the formation, and where exploited is in from one to five seams, which vary in thickness from a few inches to 30 feet. Just beyond the border of the quadrangle, along East Red Mountain, from Birmingham to Bessemer, is a practically continuous stretch of mines and strippings on the outcrop of the ore, about 15 miles

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[a] Burchard, E. F., Iron Ores in the Brookwood quadrangle, Ala.: Bull. U. S. Geol. Survey, No. 260, 1905, pp. 321-334.

in length, constituting the most extensive development of the Clinton ore that is known. The Rockwood or Red Mountain formation has been traced into the Brookwood quadrangle in strike with West Red Mountain, near Bessemer. It extends parallel to and less than 1 mile south of Rock Mountain, and is practically continuous from Valley Creek to a point about 1 mile northeast of Bibbville.

The red hematite ores are divided into two classes—the soft ores containing little calcium carbonate, and the hard ores, which contain from 12 to 20 per cent of calcium carbonate. The soft ores, usually found on the outcrop, may extend underground for 200 to 300 feet on the dip, depending on the thickness and character of the overlying material. This ore was originally identical with the hard ore, but has suffered a loss of its calcium carbonate through solution. It is consequently richer in iron and poorer in calcium carbonate. Its content in metallic iron runs from 45 to 50 per cent and in silica from 25 to 30 per cent. The hard ore, on the other hand, has the advantage of containing almost enough and at times enough lime to flux the silica which it contains. It carries from 35 to 40 per cent of metallic iron and from 12 to 18 per cent of silica. Soft and hard ores both average 0.35 per cent of phosphorus.

The valuable brown or limonite ores are widespread in Roups Valley, from the vicinity of Bucksville southwestward to where the limestone finally disappears below Cretaceous deposits along Big Sandy Creek. The deposits are variable, and it is characteristic of the brown or limonite deposits that surface indications rarely afford a true index to their extent or value. This is especially noticeable at the ore banks at Giles, where the active workings cover, roughly estimated, 5 or 6 acres, but the ore does not reach the surface. To the west of the present openings five or six test pits 50 to 60 feet deep have been sunk, in all of which there is ore about 20 feet below the surface continuing downward for from 10 to 30 feet, although no ore whatever shows at the surface.

Two partial analyses of brown ore from the Edwards ore banks at Giles show metallic iron 47.27 per cent and insoluble 16.20 per cent, and metallic iron 47.40 per cent and insoluble 15.95 per cent. The average composition of the cleaned and dried brown ore of the State banks—stock-house delivery—is metallic iron, 51 per cent; silica, 9 per cent; alumina, 3.75 per cent; phosphorus, 0.40 per cent; and sulphur, 0.10 per cent.

New York.—The continued activity in the Lake Champlain district is the reason for New York holding fourth place in 1905, with its total of 1,139,937 long tons, of which 1,050,651 tons were magnetite, the State ranking first in this class of ore, while 80,020 tons were red hematite, and 9,266 tons brown hematite ore. The increase is 297,634 tons, or 35 per cent over the 1904 output of 842,303 tons.

The exports of the high grade rich phosphoric magnetite ore from this State to Germany for the manufacture of basic steel has ceased, owing to the home demand.

The extension of some of the bodies of magnetite which have been wrought for years and the exploitation of new bodies in virgin territory give promise of the Lake Champlain district continuing an important factor in the supply of iron ores. The large quantities of titaniferous ores in northern New York, and of lean or sulphurous magnetite in the southern portion of this State may be considered as reserves for the future.

Wisconsin.—In 1904 this State ranked eighth, with a production of 483,475 long tons, which was increased in 1905 to 859,283 long tons, a gain of 375,808 long tons, or 78 per cent. Of this quantity 842,976 long tons were red hematite and the remainder, 16,307 tons, brown hematite.

Most of this ore was obtained from the Gogebic and Menominee ranges of the Lake Superior region, which extend from Michigan into Wisconsin. In the Baraboo Range there has been considerable diamond drill work and exploitation done and from one mine, in the year 1905, 78,889 tons were shipped. The interest taken in this deposit, which shows that the ore when dried at 212° contains 54 per cent iron and 0.049 phosphorus, and the convenience of the location to the blast furnaces of Illinois and Wisconsin offer encouragement to expect that this relatively new discovery may become an important factor in iron-ore production.

A paper by Dr. S. Weidman, in the Wisconsin Engineer,[a] considers the limonite ore the latest in origin and the red hematite ores of the pre-Cambrian crystalline rocks the oldest, in which class belongs the newly discovered ore in the Baraboo district.

The limonite ore at Spring Valley, which has been mined about fifteen years, is a surface deposit of typical bog ore, probably of comparatively recent geological age, and is mined from open pits.

At Iron Ridge and Mayville, in Dodge County, iron ore has been mined for fifty or sixty years. It is soft, red hematite, often called fossil or oolitic ore, and lies in regular deposits in an approximately horizontal bed, the Clinton iron-ore bed of Silurian age.

This formation appears to be well developed in Wisconsin only in Dodge County. Probably a total of two or three million tons of ore has been won since these ore deposits were first mined. The average iron content of the Clinton ore is about 45 to 48 per cent and on account of its high content of lime it is in demand for mixing with more siliceous ores of the Lake Superior district. The ore is mined by tunneling and from open pits.

The Baraboo district, outlined geologically by the Baraboo quartzite ranges or Baraboo bluffs, is located near the center of the southern half of the State, in Sauk and Columbia counties. The length of the district east and west is approximately 28 miles, and the width varies from 2 miles at the east end to 10 or 12 miles in the middle and at the west end. The area of the entire district of pre-Cambrian rocks is about 225 miles, much the larger portion of which is occupied by the Baraboo quartzite ranges. The ranges of quartzite constitute nearly a complete cordon of bluffs surrounding a depressed interior through which flows the Baraboo River.

The similarity of the Baraboo quartzites to those in the Lake Superior region led Prof. T. C. Chamberlin, a number of years ago, to suggest the possibility of iron ores being associated with them, but it was not until 1900 that iron ore was actually discovered. The ore deposits are wholly confined to the iron-bearing member of the Freedom formation, which has a thickness of about 500 feet, and lies between the gray Seeley slate below and the dolomite marble member of the Freedom formation above. While the iron-bearing member is a continuous formation in the valley (where not removed by erosion) the ore deposits occur irregularly within this member as lens-shaped bodies, containing about 54 per cent iron, and constituting those portions of the iron-bearing rock of sufficiently large extent to warrant the cost of mining. When the thickness of ore across the bedding and also along the strike of the bedding is 20 or 25 feet, with a lateral distribution of 300 to 400 feet along the dip, the bodies are generally large enough to constitute a workable deposit. Usually there is a pronounced extension of the ore parallel to the bedding in one direction.

The thickness of sandstone which overlies the iron-bearing rocks in the valley varies from 200 to 500 feet, with a possible maximum depth of the overlying formation of about 500 feet. The overlying formation of sandstone and drift is penetrated by the ordinary churn drills and the underlying formation of iron bearing and associated rock by diamond drills. In the middle portion of the valley, where the dolomite marble occurs, this rock must also be penetrated to reach the ore-bearing strata below.

Explorations carried on have developed a number of workable ore deposits in the valley southwest of North Freedom. In other portions of the valley between the quartzite ranges, the iron-bearing formation is known to occur. The result of explo-

[a] See also Am. Manufacturer, April 27, 1905.

rations, as well as the geological structure of the district, indicate that a large part of the valley is worthy of exploration, although the chances for finding ore in the various parts of it are not equally good. The portion of the valley between the bluffs in which ore may occur is about 20 miles long east and west and from one-fourth to over a mile in width. As the ore everywhere lies a considerable distance below the surface, only mining by shaft is applicable to the district. The overlying drift, consisting of sand and clay, varies locally in its content of ground water.

At the Illinois mine it was decided to penetrate the foot-wall slate by a shaft dipping 60° north and to crosscut the ore through the underlying strata. After reaching the iron formation at a depth of about 30 feet but little water was encountered, and still less at a depth of 100 feet. In mining the ore above the first level more water is encountered than lower down, on account of the proximity of the sandstone.

At the Sauk mine the ore deposit lies immediately below the sandstone in nearly flat formation, although the much crumbled rock at the bottom of the shaft has a steep local dip to the south, and it was necessary to penetrate the overlying sandstone to reach the ore deposit. The shaft was put down at an angle of 50° to the northeast.

The cost of mining and exploration in the Baraboo district will probably be higher than the average in the Lake Superior region, where sandstone is absent and only glacial drifts occur. The district, however, has the advantage of more favorable location with respect to the centers of iron production and manufacturing in Milwaukee, Chicago, and the Southwest.

Pennsylvania.—Three varieties of iron ore were mined in the year 1905, and of this 637,857 long tons were magnetite; 166,435 tons brown hematite and 4,425 tons red hematite. The gain of 411,610 tons gave the State sixth place, with a total of 808,717 tons, or more than double the 1904 product of 397,107 tons. This increase was largely due to activity in the Cornwall Ore Hills. The State has large reserves of comparatively low grade brown hematite, magnetite, red hematite, and carbonate ores, which can be made available in case of need.

Virginia and West Virginia.—These two States have been grouped together in order to preserve the confidential character of the report, but practically all of the 752,045 long tons of iron ore mined in 1905 came from Virginia. Of this quantity 716,170 tons were of the brown hematite variety, in which class of ore the States ranked second. Of the remainder, 35,357 long tons were red hematite ore and 518 tons magnetite. The 1905 total was 201,792 tons, or 37 per cent, greater than in 1904, when 550,253 long tons were won.

Tennessee.—In the year 1905, 734,770 tons of iron ore were mined in Tennessee, of which 461,774 tons were brown hematite and 272,996 tons red hematite, being an increase of 233,788 tons, or 47 per cent over the 1904 total of 500,982 long tons. It occupied sixth position as a producer of red hematite ore, and third of brown hematite.

Mr. F. Lynwood Garrison describes[a] the iron ores of Shady Valley, near the center of Johnson County, the extreme northeastern portion of Tennessee. He states that the geology of Shady Valley, as of the neighboring Doe Valley, resembles in a general manner the synclinal troughs occurring in the same rocks elsewhere in the Appalachian system. The Paleozoic rocks are here folded, faulted, and crumbled up in much the same way as in other sections of this great continental flexure.

The predominating and characteristic formations, giving their local designation and geological sequence of superposition, are Wautaga shale, Shady limestone, Erwin quartzite, and the Hampton shale, all belonging to the Cambrian period.

The Shady limestone formation derives its name from the valley of which it probably constitutes the floor, and consists mainly of limestone 750 to 800 feet thick, of a bluish or gray color, weathering on outcrop to a dull blue or black. Some of the

[a] Eng. and Min. Jour., October 13, 1904.

layers are mottled, blue, gray, and white, often seamed with calcite. Thin seams of blue and gray shale occur in many parts of the formation. Siliceous impurities, in the form of sand, and especially of chert, are frequent.

Decay proceeds faster in this formation than in any other in the region, its clays are deep and strong, but often so covered with detritus from the other formations as to impoverish the naturally fertile soil. The iron ores which occur in the clays of the Shady limestone formation belong to the Cambrian period and not to the Marcellus formation of the Devonian, the Oriskany of the Upper Silurian, nor the Trenton of the Lower Silurian. The clay beds are usually covered with 1 to 30 feet of detrital material, composed of rounded pebbles and bowlders of sandstone, quartzite, with clay and humus.

The presence of iron ores in these clays is decidedly irregular, the continuity of the ore-bearing material being interrupted by beds and masses of white, pink, or light yellow clay that contains no ore. It often happens, however, that under these barren places good ore-bearing clay will be found. At greater depths than have yet been reached it is not unlikely the ore-bearing clay may be less irregular, but near the surface these barren places must be reckoned with.

The depth or thickness of ore-bearing clay beds is undetermined, shafts 40 to 50 feet deep having been sunk without reaching rock (limestone) bottom. The probabilities are that they vary greatly in this particular, owing to the cavernous character of the basal limestone. In several instances shafts 30 to 50 feet deep have penetrated beds, carrying ore from within 2 or 3 feet of the top to the bottom. Where the larger masses of ore predominate, it is not unlikely they represent a replacement of the limestone by iron-bearing solutions rather than ordinary bog-ore deposits.

The Shady Valley ores in concentration and fault deposits are essentially limonite; their occurrence is massive, earthy, concretionary, nodular, and occasionally stalactitic. The concretionary or nodular forms are most common, often occurring in hollow spherical masses, as pot or bombshell ore. Concretionary structures, the prevailing characteristic of the ore, vary in size from fine grains to masses several feet in diameter. This material constitutes the bulk of what is known as "wash ore," and yields a merchantable product after having passed through the mill or washer that separates and removes the ore particles from the accompanying clay. The clays also contain masses of lump ore, usually found from 10 to 25 feet below the surface, but nearly always overlaid, as well as underlaid, by wash ore. This lump ore often consists of solid masses up to 5 or 6 feet in thickness, and carries no gangue, except the clay occupying seams and cavities in the mass, so that when the lumps are washed they generally have a more or less honeycombed appearance. Then again the massive ore has a laminated structure, and breaks in distinct layers like an onion.

The composition of the Shady Valley ores may be noted from the accompanying table. Some of the samples were from surface outcroppings, well washed by the rains for many years, consequently the percentage of iron is higher and that of silica lower than is obtained as an average result with mechanical washers, when 48 per cent iron and 10 to 12 per cent silica may be considered excellent practice. Nos 1, 8, 9, 12, 37, and 42, of the table are considered "fault deposit" or "mountain ores," all the others are from concentration or segregated deposits, or, as they are sometimes denominated, "limestone ores."

Analyses of Shady Valley, Tennessee, iron ores.

Number.	Iron.	Manganese.	Phosphorus.	Silica.	Number.	Iron.	Manganese.	Phosphorus.	Silica.
3	56.37	0.394	0.168	4.92	34	48.85	0.24	0.14	12.60
5	47.57	7.410	0.055	2.50	35	47.15	0.84	0.13	12.65
6	57.20	0.394	0.046	3 80	39	57.27	1.02	0.044	2.90
7	57.56	0.789	0.115	2.24	1	53.53	0.366	0.252	6.15
15	44.73	3.72	0.114	14.61	8	57.26	0.225	0.185	5.25
18	47.05	0.87	0.224	14.33	9	57.22	0.084	0.285	7.72
19	57.80	0.33	0.08	4.75	12	54.16	0.141	0.907	5.83
21	53 30	0 45	0.14	10.20	37	50.35	0.12	1.02	12.00
24	60.75	1.25	....	....	42	54.70	0 03	0.11	....

New Jersey.—All of the 526,271 long tons of iron ore mined in New Jersey in 1905 were of the magnetite variety, in which class the State ranked third. This was an increase of 26,322 tons, or 5 per cent, over the 1904 production of 499,949 tons.

In late years some of the older New Jersey iron-ore mines which had been abandoned have been reopened, and these account for the augmentation of the output.

Georgia and North Carolina.—Of the 257,124 tons of iron ore contributed by these States in the year 1905, 155,434 tons were brown hematite, 56,282 tons magnetite, and 45,408 tons brown hematite ore. These States combined show a falling off of 101,025 tons, or nearly one-third, from the 1904 total of 358,149 tons.

Mr. W. B. Lowe, in a contribution to the Manufacturers' Record of December 28, 1905, gives a description of the Etna iron-ore properties in Polk County, Ga.

These deposits were formed by precipitation and sedimentation as a bog ore. Indian Mountain is an upthrust, around which fault lines occur, and strike in a northeasterly direction, paralleling the deposits of brown ore. The ore is massive near these faults, probably several hundred feet in thickness. It gradually thins out to a few feet, going east and west from the faults of this mountain. Probably these faults afforded a conduit for the waters which deposited this ore, and the persistent parallelism of the deposits to these fault lines lends considerable evidence to strengthen this view.

The Etna deposit is about 4½ miles in width at its center, and extends from the quartzite cropping of Indian Mountain on the west to where the quartzite on the east of the property forms an anticline or ridge, which divides the Cedertown and Etna deposits. This deposit is of a good grade of ore, as shown by the following analyses:

Analyses of Etna iron ore, Polk County, Ga.

No.		Metallic iron.	Phosphorus
1	Massive ore from 60 foot face	50 42	0.77
2	Shot ore	47 61	.16
3	... .do	46.63	.15
4	Massive ore	57 49	.61
5	.....do	53.61	.90

Colorado.—Of the 133,471 tons of iron ore mined in Colorado, 131,317 tons were brown hematite and 2,154 tons red hematite. This was a decline of 17,501 tons, or 12 per cent, from the 1904 total of 150,972 long tons. The suspension of operations at the most important brown hematite mine is responsible for the decline in that class of ore.

Missouri.—Missouri advanced from a total of 49,285 long tons in 1904 to 113,012 long tons in 1905, a gain of 63,727 long tons, almost one and one-third times the former quantity. Of this 78,746 tons were red hematite and 34,266 tons brown hematite.

Montana, New Mexico, Nevada, Texas, Utah, and Wyoming.—In order to preserve the confidential nature of the report these Western States have been combined, and show a total of 714,978 long tons of iron ore produced in 1905, which is approximately three and a half times greater than the 1904 product of 210,945 long tons. Of this amount 557,619 tons were red hematite ore, 118,838 tons magnetite, and 38,521 tons brown hematite ore.

Wyoming was by far the largest contributor of iron ore, the deposits exploited by the Colorado Fuel and Iron Company, near Sunrise, having produced, in 1905, 474,545 long tons. Exploratory and development work indicates that this deposit is destined to rank among the important iron-ore supplies of the United States, and two lines of railroad have been constructed to convey the mineral to the steel works at Pueblo.

Considerable exploitation has been going on in the Rocky Mountain region, and there are also reports of examinations being made of deposits said to exist near the Pacific coast.

Other States.—None of the remaining States contributed 100,000 long tons of ore. Connecticut and Massachusetts supplied brown hematite ore, Kentucky red hematite, Ohio carbonate, Maryland brown hematite and carbonate ores, and Arkansas manganiferous brown hematite.

SHIPMENTS OF IRON ORE FROM THE LAKE SUPERIOR REGION.

The greater portion of the iron ore mined in the United States is obtained from the territory tributary to Lake Superior, and thence taking its name of Lake Superior region, which in the year 1905 produced 33,325,018 long tons of iron ore, and shipped 34,241,498 tons, the surplus being taken from stock. The bulk of this ore is forwarded from shipping ports on Lake Superior and Lake Michigan by vessel to the docks at the lower lake ports on Lake Erie, from which it is sent by rail to blast furnaces in Pennsylvania, Ohio, West Virginia, Virginia, etc.—in one case of temporary need being transported as far as Colorado—and to receiving ports at Chicago, Milwaukee, etc.

There are five shipping ports on Lake Superior: Duluth and Two Harbors in Minnesota; Superior and Ashland in Wisconsin; and Marquette in Michigan; while two ports, Escanaba and Gladstone, are on Lake Michigan, both being in the State of Michigan. The last mentioned port made no shipment of ore in 1905.

Duluth, Minn., leads in 1905 as a shipping port with 8,807,559 long tons, followed by Two Harbors with 7,779,850 tons; Escanaba, with 5,307,911 tons; Superior, with 5,118,385 tons; Ashland, with 3,485,344 tons, and Marquette, with 2,977,288 tons. With the exception of Escanaba and Ashland, these figures represent maximum annual shipments.

The iron ore obtained from the Mesabi and Vermilion ranges in Minnesota is shipped via Two Harbors, Duluth, and Superior. From the Gogebic Range in Michigan and Wisconsin the ore goes via Ashland; from the Marquette Range in Michigan via Marquette and Escanaba; and the Menominee Range ores from Michigan and Wisconsin are shipped from Escanaba, some of the Gogebic ore also reaching the latter port.

The shipments by ports from 1900 to 1905, inclusive, as copied from the Iron Trade Review, is as follows:

Lake shipments of iron ore, 1900–1905.

[Long tons.]

Shipping port.	1900.	1901.	1902.	1903.	1904.	1905.
Two Harbors	4,007,294	5,018,197	5,605,185	5,120,656	4,566,542	7,779,850
Escanaba	3,436,734	4,022,668	5,413,704	4,277,561	3,644,267	5,307,911
Duluth	3,888,986	3,437,955	5,598,408	5,356,473	4,649,611	8,807,559
Ashland	2,633,687	2,886,252	3,553,919	2,823,119	2,288,400	3,485,344
Marquette	2,661,861	2,354,284	2,595,010	2,007,346	1,907,301	2,977,288
Superior	1,522,899	2,321,077	4,180,568	3,978,579	4,169,990	5,118,385
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	33,476,337
All-rail shipments	489,078	431,715	531,952	632,045	548,253	765,161
Grand total	19,059,393	20,589,237	27,571,121	24,281,595	21,774,917	34,241,498

The total iron-ore traffic of the Great Lakes in 1905 was 33,645,864 long tons, of which 33,476,337 tons were shipped from American ports and 169,527 long tons from Michipicoten Harbor, Canada, the latter coming from the Michipicoten Range, which in 1905 produced 179,900 long tons of ore.

The greater part of this ore was sent to Lake Erie ports, the quantity received in 1905 being 28,941,259 long tons, the maximum quantity handled at these docks in any one year. The difference between this quantity and that sent from upper lake ports represents the quantity sent to furnaces at or near Lake Michigan, at Detroit, etc.

In 1905 Ashtabula, Ohio, occupied first place, with 6,373,779 long tons; Cleveland was second, with 5,854,745 tons; Conneaut third, with 5,327,552 tons, followed by Buffalo and Tonawanda, N. Y., 3,774,928 tons; Erie, Pa., 2,112,476 tons; Fairport, Ohio, 2,008,621 tons; Lorain, Ohio, 1,605,823 tons; Toledo, Ohio, 1,006,855 tons; Huron, Ohio, 825,278 tons; and Sandusky, Ohio, 51,202 tons. With the exception of Toledo and Sandusky, these figures represent maximum receipts.

The table below shows the amounts received annually at each port on Lake Erie for the years 1900 to 1905, inclusive.

Iron-ore receipts at Lake Erie ports, 1900–1905.

[Long tons.]

Port.	1900.	1901.	1902.	1903.	1904.	1905.
Ashtabula, Ohio	3,709,486	3,981,170	4,796,805	4,242,160	3,639,250	6,373,779
Cleveland, Ohio	3,376,644	3,831,060	4,873,318	4,434,160	3,572,228	5,854,745
Conneaut, Ohio	2,556,631	3,181,019	4,300,301	3,903,937	4,083,655	5,327,552
Buffalo and Tonawanda, N. Y.	1,616,919	1,475,386	2,256,798	2,149,901	2,433,601	3,774,928
Erie, Pa.	1,240,715	1,379,377	1,717,268	1,257,798	1,284,778	2,112,476
Fairport, Ohio	1,085,551	1,181,776	1,538,744	1,434,342	1,157,858	2,008,621
Toledo, Ohio	645,147	798,298	1,037,571	652,305	508,793	1,006,855
Lorain, Ohio	1,090,235	721,662	1,442,417	990,490	972,931	1,605,823
Huron, Ohio	321,914	431,311	520,646	486,106	231,364	825,278
Sandusky, Ohio	154,542	33,017	165,556	130,532	48,356	51,202
Total	15,797,787	17,014,076	22,649,424	19,681,731	17,932,814	28,941,259

The various railroads connecting the shipping ports with the mines of the Lake Superior region have erected expensive docks, many of large size. Through the courtesy of Mr. R. Angst, chief engineer of the Duluth and Iron Range Railroad, a list, revised to May 1, 1906, is presented, which gives location of the dock, name of railway, number of pockets, total capacity, etc.

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

Railway.	Location.	Dock No.	Number of pockets.	Storage capacity.	Height water to deck of dock.	Width of dock outside to outside of partition posts.	Length of dock.
				Tons.	*Ft. in.*	*Ft. in.*	*Ft. in.*
Chicago and Northwestern Rwy.	Escanaba, Mich.	1	184	24,104	48 6	37 0	1,104 0
Do	do	3	226	30,284	52 8	37 0	1,356 0
Do	do	4	250	32,750	59 2	37 0	1,500 0
Do	do	5	232	43,152	53 3	37 0	1,392 0
Do	do	6	320	58,000	70 0	50 2	1,920 0
Do	Ashland, Wis.	1	234	42,120	70 0	48 0	1,404 0
Do	do	2	234	25,740	57 8	46 0	1,404 0
Total			1,680	256,150			
Duluth and Iron Range R. R.	Two Harbors, Minn.	1	202	40,400	59 6	49 0	[b]1,388 0
Do	do	2	208	41,600	57 6	49 0	1,280 0
Do	do	3	170	34,000	66 0	49 0	1,054 0
Do	do	4	168	36,960	62 0	49 0	1,042 0
Do	do	5	168	33,600	54 6	49 0	1,042 0
Total			916	186,560			
Duluth, Missabe and Northern Rwy.	Duluth, Minn.	1	384	57,600	53 0	49 0	2,336 0
Do	do	2	384	69,120	57 6	49 0	2,336 0
Do	do	3	384	80,640	67 0½	59 0	2,304 0
Do	do	4	384	119,274	72 6	57 0	2,304 0
Total			1,536	326,634			
Great Northern Rwy	Superior, Wis.	1	250	40,500	57 0	49 0	1,525 0
Do	do	2	350	87,500	72 8	62 8	2,100 0
Do	do	3	326	81,500	72 8	62 8	1,956 0
Total			926	209,500			
Duluth, South Shore and Atlantic Rwy.	Marquette, Mich.	1	270	27,000	45 0	40 0	1,700 0
Do	do	4	200	28,000	47 3	36 8	1,200 0
Do	do	5	200	50,000	70 10	51 0	1,236 0
Total			670	105,000			
Lake Superior and Ishpeming Rwy.	Marquette, Mich.	1	200	36,000	54 0	50 0	1,232 0
Wisconsin Central Rwy	Ashland, Wis.	1	314	48,356	66 2	36 0	1,908 0
Chicago, Milwaukee and St. Paul Rwy.	Escanaba, Mich.	1	240	50,400	66 6	52 0	1,500 0
Do	do	2	240	63,500	69 2	54 0	1,500 0
Total			480	113,900			
Algoma Central and Hudson Bay Rwy.	Michipicoten, Ontario.	1	12		43 4	25 0	311 9

[a] Revised to May 1, 1906. [b] 312 feet single pockets, 1,076 feet double pockets.

During the year 1905 a number of steamers carrying iron ore were wrecked by severe storms and a considerable quantity of ore was lost.

On arrival at lower lake ports the iron ore is usually loaded directly into railroad cars which convey it to blast furnaces, or else it is stocked on the docks, being drawn on during the winter months. The quantity of ore on hand at the lower lake ports on December 1, 1905, was 6,758,511 long tons, being the largest stock since 1902, when 7,074,254 tons were reported. It was an increase of 995,112 tons, or 17 per cent, over the stock of 5,763,399 tons on hand December 31, 1904.

The following table gives the stock of ore on hand at Lake Erie ports on December 1 for the years 1900 to 1905, inclusive:

Stocks of iron ore at lower lake ports, December 1, 1900–1905.

[Long tons.]

Port.	At close of navigation, December 1—					
	1900.	1901.	1902.	1903.	1904.	1905.
Ashtabula, Ohio	1,811,459	1,769,145	1,967,136	1,911,911	1,403,575	1,909,495
Cleveland, Ohio	1,337,445	1,378,060	1,500,604	1,337,750	1,237,033	1,330,619
Fairport, Ohio	611,717	710,590	924,236	845,946	660,420	759,961
Erie, Pa	480,734	470,718	722,966	657,409	583,439	564,961
Lorain, Ohio	251,838	195,863	328,304	288,581	299,504	271,695
Conneaut, Ohio	630,514	604,106	673,679	591,364	684,487	976,976
Toledo, Ohio	242,375	254,196	310,023	106,710	318,573	368,024
Huron, Ohio	211,377	231,501	232,764	253,249	182,495	208,023
Buffalo, N. Y	232,100	198,100	319,367	282,890	318,739	315,780
Sandusky, Ohio	95,111	47,384	95,175	95,275	75,134	52,977
Total	5,904,670	5,859,663	7,074,254	6,371,085	5,763,399	6,758,511

The stocks of ore on docks at Lake Erie ports are drawn upon during the season when lake navigation is suspended, but usually are not exhausted, the amount on hand May 1, 1906, being 1,791,090 long tons, the smallest quantity since 1900, when it was 1,720,656 tons.

The stocks of ore on hand at lower lake ports on May 1 for the years 1901 to 1906, inclusive, as given by the Iron Trade Review, were:

Stocks of iron ore at lower lake ports, May 1, 1901–1906.

[Long tons.]

Port.	At opening of navigation, May 1—					
	1901.	1902.	1903.	1904.	1905.	1906.
Ashtabula, Ohio	1,046,974	924,742	1,073,967	1,559,028	623,451	462,564
Cleveland, Ohio	806,119	624,865	829,347	968,508	513,559	350,382
Fairport, Ohio	306,706	472,325	555,709	579,677	390,869	266,162
Erie, Pa	225,412	223,972	426,744	474,275	236,414	169,488
Lorain, Ohio	140,562	96,992	190,311	237,404	165,586	140,452
Conneaut, Ohio	69,755	152,891	125,400	128,018	96,295	148,528
Toledo, Ohio	138,457	111,511	126,331	160,216	71,642	52,550
Huron, Ohio	135,043	129,635	147,817	208,008	68,100	80,738
Buffalo, N. Y	118,007	73,861	60,241	150,106	61,271	90,906
Sandusky, Ohio	63,148	37,400	56,500	68,863	44,441	29,320
Total	3,050,183	2,848,194	3,592,367	4,534,103	2,271,631	1,791,090

PROMINENT IRON-ORE MINES.

In the year ending December 31, 1905, there were 140 iron-ore operations, which produced over 50,000 long tons each, the total being 39,320,069 long tons, or 92 per cent of the United States output. In 1903 there were 141 mines, which produced 31,301,938 long tons, or 89 per cent of the output of the United States, and in 1904 there were 117 mines, which produced 24,993,414 long tons, or 90 per cent of the output of the United States.

In 1905, of these larger mining operations, 117 contributed 35,895,114 long tons of red hematite, 11 supplied 1,019,123 long tons of brown hematite, 11 reported 2,093,776 long tons of magnetite, and 1 produced 312,056 tons mixed red and brown hematite. Of these operations 1 reported over 2,500,000 tons, 1 between 1,500,000 and 2,000,000 tons, 7 between 1,000,000 and 1,500,000 tons, 3 between 750,000 and 1,000,000 tons, 4 between 500,000 and 750,000 tons, 26 between 250,000 and 500,000 tons, 55 between 100,000 and 250,000 tons, and 43 between 50,000 and 100,000 tons.

Of these larger mining operations 56 were in Minnesota, 42 in Michigan, 17 in Alabama, 5 in Wisconsin, 4 each in New York, New Jersey, and Virginia, 2 in Tennessee, and 1 each in Georgia, North Carolina, New Mexico, Nevada, Pennsylvania, and Wyoming.

The following table gives a list of the mining operations in the United States, which in the year 1905 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 20 mines, the managers of which objected to such publication, and these are grouped at the end of the table.

Prominent iron-ore mines of the United States, with their production in 1905.

	Long tons.
Mountain Iron, Minnesota	2,500,570
Burt, Minnesota	1,861,680
Stevenson, Minnesota	1,428,602
Fayal, Minnesota	1,363,869
Red Mountain Group, Alabama	1,211,976
Adams, Minnesota	1,126,649
Biwabik, Minnesota	1,093,042
Morris, Minnesota	1,071,315
Mahoning, No. 3, Minnesota	1,014,852
Chapin, Michigan	956,968
Norrie Group (Norrie & Pabst), Michigan	802,136
Lake Superior, Michigan	755,392
Pioneer, Minnesota	654,816
Cleveland Lake, Michigan ... 551,304; Cleveland Hard Ore, Michigan 76,244	627,548
Cornwall Ore Bank Company, Pennsylvania	617,157
Spruce Mining Company, Minnesota	585,934
Pewabic, Michigan	493,655
Aurora and Vaughn, Michigan	482,551
Sunrise, Wyoming	474,545
Aragon, Michigan	430,134
Lone Jack and Mesabi Mountain, Minnesota	402,224
Newport and Bonnie, Michigan	400,404
Stephens, Minnesota	367,764
Brier Hill, Vulcan, Norway, etc. (Penn Mining Company), Michigan	365,487
Leetonia, Minnesota	352,118
Chandler, Minnesota	351,323
Ashland, Michigan	345,448
Clark, Minnesota	342,116
Hartford, Michigan	336,853
Chateaugay, New York	330,252
Savoy-Sibley, Minnesota	316,738
Lincoln, Minnesota	308,683
Leonard, Minnesota	297,022
Lake Angeline, Michigan	288,536
Glen, Minnesota	285,354
Rust, Minnesota	283,678
Old Bed, New York	275,113
Regent Iron Company, Michigan	262,011
Sellers, Minnesota	256,527
Hull, Minnesota	251,679
Higgins, Minnesota	246,740
Tobin and Gennessee, Michigan	246,123
Negaunee, Michigan	243,301
Albany, Minnesota	240,037
Cyprus, Minnesota	235,352
Chisholm, Minnesota	234,082
Cliff's Shaft, Michigan	230,915
Genoa, Minnesota	229,725
Shenango, Minnesota	222,477
Florence, Wisconsin	216,266
Bristol (Claire), Michigan	214,500
Great Western, Michigan	208,662
Tilden, Michigan	207,252
Hawkins, Minnesota	202,070
La Rue Mining Company, Minnesota	201,042
Port Henry, No. 21, New York	199,296
Myers, Minnesota	190,239
Brown Mining Company, Tennessee	189,783
Commodore, Minnesota	186,591

Prominent iron-ore mines of the United States, with their production in 1905—Continued.

	Long tons.
Jordan, Minnesota	185,789
Utica, Minnesota	179,887
Atlantic, Wisconsin	179,808
Soudan, Minnesota	166,075
Pillsbury, Minnesota	162,058
Holland, Minnesota	161,700
Odanah Iron Company, Wisconsin	160,275
Harmony, New York	150,734
Mikado, Michigan	149,858
Salisbury, Michigan	149,664
Crystal Falls, Michigan	149,394
Brotherton, Michigan	147,245
Baltic, Michigan	145,935
Republic and West Republic, Michigan	144,311
Elba, Minnesota	144,035
Duluth, Minnesota	142,172
Malta, Minnesota	139,040
Clifford, Michigan	138,805
Montreal and Ottawa, Wisconsin	138,609
Princeton, Michigan	138,062
Croxton, Minnesota	134,654
Hemlock River, Michigan	125,385
Oriskany, Virginia	123,330
Miller, Minnesota	121,722
Vivian, Michigan	114,078
Fierro, New Mexico	113,838
Dober, Isabella, etc. (Riverton Group), Michigan	111,749
Songo, Alabama	107,224
Lacey-Buek Iron Company, Alabama.	106,780
Minorca, Minnesota	103,615
Troy, Minnesota	99,410
Richards, New Jersey	98,590
Wood and De Camp, New Jersey	97,878
Loretto, Michigan	95,417
Greeley Group, Alabama	92,865
Munro, Michigan	92,182
Nanaimo, Michigan	91,336
Zenith, Minnesota	89,674
Sunday Lake, Michigan	86,922
Webb, Minnesota	86,406
Richmond (Gribbin), Michigan	85,369
Munro-Tener, Minnesota	85,216
Lamont, Michigan	82,453
Wharton-Hibernia, New Jersey	82,365
Illinois Iron Mining Company, Wisconsin	78,889
Colby, Michigan	75,913
Hammond Brothers & Co., Alabama	75,525
Frantz, Minnesota	73,027
La Belle, Minnesota	71,596
Mannie, Tennessee	71,510
Potter, Alabama	70,213
Morrow, Minnesota	61,882
Austin, Michigan	61,813
Bartow, Georgia	61,228
Iroquois, Minnesota	61,109
Yale, Michigan	60,913
Case, Minnesota	59,913
Cambria, Michigan	58,285
Lillie, Michigan	57,337
Fenwick, Virginia	56,585
Giles, Alabama	53,681
	36,728,507
20 mines not reported by name	2,591,562
Total	39,320,069

VALUE OF IRON ORES.

The total value at the mines of the 42,526,133 long tons of iron ores mined in the United States in the year 1905 was \$75,165,604, an average per ton of \$1.77, an apparent increase of 21 cents per ton, or 13 per cent, over the average value of \$1.56 per ton in 1904.

The data collected show that the highest value placed on ore in 1905 was \$3 per ton for the brown hematites mined in Connecticut and Massachusetts, and that the lowest was an average of \$1 per ton for the red and brown hematites of Kentucky and Iowa. All of the States comprising the Lake Superior region show an increase in value, Michigan having risen from \$1.97 per ton in 1904 to \$2.15 in 1905, Wisconsin from \$1.77 to \$2, and Minnesota from \$1.43 to \$1.65. The majority of the States show an increase in the average value, the only decline being in the cases of Virginia and West Virginia, Missouri, Ohio, and Maryland.

The following table gives the production of iron ore by States in 1905, the total value of the product at the mines, and the average value per ton:

Quantity and value of iron ore produced in 1905 by States.

[Long tons.]

State.	Production.	Total value at mines.	Average value per ton.
Minnesota	21,735,182	$35,895,001	$1.65
Michigan	10,885,902	23,367,233	2.15
Alabama	3,782,831	4,257,155	1.13
New York	1,139,937	3,197,919	2.81
Wisconsin	859,283	1,718,890	2.00
Pennsylvania	808,717	1,060,162	1.31
Virginia and West Virginia	752,045	1,276,903	1.70
Tennessee	734,770	918,850	1.25
Montana, Nevada, New Mexico, Texas, Utah, and Wyoming	714,978	1,123,453	1.57
New Jersey	526,271	1,269,374	2.41
Georgia and North Carolina	257,124	370,101	1.44
Colorado	133,471	398,700	2.99
Missouri	113,012	161,878	1.43
Connecticut and Massachusetts	25,931	77,278	3.00
Kentucky and Iowa	25,100	25,150	1.00
Ohio	19,989	26,624	1.33
Maryland	8,269	14,291	1.73
Arkansas	3,321	6,642	2.00
Total	42,526,133	75,165,604	1.77

STOCKS OF IRON ORE.

There was on hand at the mines at the close of the year 1905 a stock of 3,812,281 long tons, a decline of 854,650 tons, or 18 per cent, from the 4,666,931 tons on hand December 31, 1904.

The three States of Minnesota, Michigan, and Wisconsin, forming the Lake Superior region, had on hand December 31, 1905, 3,302,434 long tons, or 87 per cent of the total for the whole of the United States. This accumulation is due to the fact that during the winter months navigation on the Great Lakes, over which the ore is forwarded, is suspended, the ore being generally stocked at the mines.

The annexed table gives the quantity of iron ore on hand at the mines on December 31, 1905, by States:

Stock of iron ore on hand at the mines December 31, 1905, by States.

[Long tons.]

Michigan	2,097,156
Minnesota	1,088,501
Montana, Nevada, New Mexico, Texas, Utah, and Wyoming	173,600
Alabama	177,119
Wisconsin	116,777
New York	50,428
New Jersey	28,139
Tennessee	24,130
Pennsylvania	20,497
Ohio	17,450
Missouri	6,040
Georgia and North Carolina	5,966
Virginia and West Virginia	3,940
Connecticut, Massachusetts, and Vermont	2,538
Total	3,812,281

In previous pages the stocks of ore on hand at lower lake ports have been mentioned, and if these were added to the stocks reported at the mines the sum would still not represent all the ore available, for ore is accumulated at many of the blast furnaces. However, much of this accumulation is like the stocks at lower lake ports, intended merely to carry the plants through the winter.

No attempts have been made to determine the quantity of ore held at blast furnaces, but the table on page 6 gives the stocks of ore reported at the mines in the United States and the stocks of Lake Superior ores at lower lake ports from 1889 to 1905, from which the relation of production to stocks can be determined.

IMPORTS OF IRON ORE.

The imports of iron ore into the United States in the calendar year 1905 were 845,651 tons, valued at $2,062,161, the average value being $2.44 per ton, as against 487,613 long tons, valued at $1,101,384, or $2.26 per ton, which were brought in in the year 1904. The Bureau of Statistics of the Department of Commerce and Labor has furnished data in regard to both the imports and the exports of iron ore in the year 1905. The quantity of ore imported from Cuba in 1905 was 539,935 long tons; 191,861 tons came from Spain; 104,096 tons from Quebec, Ontario, etc. (most of which was from the Michipicoten Range); 5,600 tons from Newfoundland and Labrador; and the remainder was scattered, being obtained from the United Kingdom, Belgium, etc.

The table following shows the imports of iron ore by countries from 1902 to 1905, inclusive:

Quantity and value of iron ores imported into the United States, 1902–1905, by countries.

[Long tons.]

Country.	1902.		1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Cuba	696,375	$1,576,619	613,585	$1,501,480	364,630	$822,413	539,935	$1,437,900
Spain	153,527	338,259	94,720	196,139	36,810	89,218	191,861	366,436
French Africa	19,167	35,707	7,830	14,586				
Greece					2,500	2,535		
Newfoundland and Labrador	81,920	81,918	[a] 86,730	86,680	5,400	5,400	5,600	5,600
United Kingdom	1,269	17,882	6,843	31,868	173	2,093	408	2,396
British Columbia	5,661	9,312	525	789				
Germany	361	3,478	207	1,820	2	70	1	42
Netherlands					1	10		
Quebec, Ontario, etc.	203,824	509,711	169,681	424,440	77,887	177,966	104,096	240,303
Belgium	500	4,850	300	2,964	210	1,671	400	3,370
France	2,866	5,341				8		
Other countries			19	242			3,350	6,114
Total	1,165,470	2,583,077	980,440	2,261,008	487,613	1,101,384	845,651	2,062,161

[a] Newfoundland only.

It will be noted that 77 per cent of the iron ore brought into the United States is obtained in the western hemisphere.

Of the foreign iron ore brought into this country in the year 1905, 741,155 long tons were received at the Atlantic ports, Baltimore, Md., leading with a total of 504,618 long tons, followed by Philadelphia, 201,853 tons; New York, 34,296 tons; the small balance going to Boston, Mass., and Richmond, Va. At the lake ports 104,096 tons were imported, of which 57,446 tons came to Cuyahoga, Ohio. At the Pacific ports but 400 tons were received.

In the following table the imports of iron ore into the United States in the years 1902 to 1905, by customs districts, are given:

Imports of iron ore into the United States, 1902–1905, by customs districts.

[Long tons.]

Port.	1902.		1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Baltimore, Md	600,711	$1,401,326	490,920	$1,232,546	321,920	$738,010	504,618	$1,290,420
Philadelphia, Pa	338,848	597,895	303,722	560,880	72,186	143,892	201,853	455,342
New York, N. Y	14,546	39,800	6,940	19,759	15,263	38,765	34,296	70,419
Boston, Mass	50	142	650	2,435	132	904	268	1,261
Newport News, Va	197	8,130	3,397	8,825				
Richmond, Va					20	168	120	1,046
Total Atlantic ports	954,352	2,047,293	805,629	1,824,445	409,521	921,739	741,155	1,818,488
Buffalo Creek, N. Y	53,286	133,377	23,167	57,798	56	85	9,468	21,715
Cuyahoga, Ohio	123,476	308,951	122,021	305,804	48,945	111,974	57,446	132,127
Champlain, N. Y	34	38	171	928			20	30
Detroit, Mich	73	112	55	133			13,929	32,036
Genesee, N. Y							3,840	8,832
Oswegatchie, N. Y	139	209	182	273	37	56	18	36
Vermont	18	72	760	1,190	1,183	2,457	529	1,043
Erie	22,821	57,024	23,325	58,314	27,661	63,394	18,846	44,484
Miami	3,962	9,905						
Total lake ports	203,809	509,688	169,681	424,440	77,882	177,966	104,096	240,303
Saluria, Tex. (total Gulf ports)			4,100	6,560				
Puget Sound, Wash	5,661	9,312	525	789				
San Francisco, Cal	1,241	12,581	200	1,989	210	1,671	400	3,370
Los Angeles, Cal	357	3,461	305	2,785				
Total Pacific ports	7,259	25,354	1,030	5,563	210	1,671	400	3,370
Pittsburg, Pa	50	742						
Columbus, Ohio						8		
Total interior ports	50	742				8		
Total imports	1,165,470	2,583,077	980,440	2,261,008	487,613	1,101,384	845,651	2,062,161

EXPORTS OF IRON ORE.

The exports of iron ore from the United States in the year 1905 were 208,017 tons, valued at $530,457, the bulk of which was sent to furnaces in Ontario, Canada, as a mixture with local ores. With the exception of the year 1904, when 213,865 tons of ore were exported, this is the largest total since the forwarding of iron ore out of the country first became of prominence in the year 1899. The larger total for 1904 was due to demand for ores rich in iron and high in phosphorus for use in the manufacture of basic pig in Germany, which led to the exportation of the ore from the Port Henry district in New York; owing to an augmented home demand, however, the shipment ceased in 1905.

The accompanying table gives the exports of iron ore from the United States from 1902 to 1905, inclusive, by customs districts:

Exports of iron ore from the United States for the calendar years 1902–1905, by customs districts.

[Long tons.]

Customs district.	1902.		1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
New York	204	$2,227	331	$2,000	25,779	$51,718	200	$413
Niagara	802	1,708						
Superior	19,157	63,772	70,870	223,432	138,946	270,309	94,216	199,033
Duluth	49,233	152,454	5,006	13,463	38,582	113,664	93,364	280,097
Detroit	115	408						
Huron					18	171	31	169
Champlain	18,876	73,348	4,314	16,548	10,284	22,009	16,686	38,824
Buffalo Creek	58	251	90	285	176	502	2,350	7,061
Puget Sound					80	450	1,170	4,860
Total	88,445	294,168	80,611	255,728	213,865	458,823	208,017	530,457

In all the tables of imports and exports of iron ore, the values given are the prices at the ports of shipment and do not include freights, nor the duty of 40 cents per ton. The comparatively high values of some small imports are due to constituents other than iron, or to special adaptability for specific purposes.

CUBA.

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

Of the four companies which mined iron ore in this island, two—the Sigua Iron Company, which operated in 1892 and 1893, and the Cuban Steel Ore Company, which was active in 1901 and 1902—have been abandoned. The Juragua Iron Company (Limited), the pioneer iron-ore operation, first shipped ore in the year 1884 and has contributed, to the close of the year 1905, 4,238,683 long tons. The Spanish-American Iron Company, which made its initial shipments in 1895, has supplied 3,022,283 long tons to the end of the year 1905.

Iron-ore deposits also exist in other parts of the island of Cuba, a number of bodies of ore in the province of Puerto Principe being controlled by the Cuban Mining Company. A report of these ores has been made by Mr. B. F. Fackenthal, jr., president of the Thomas Iron Company, and the analyses are as follows:

Analyses of iron ores from Puerto Principe, Cuba.

	El Yman mine.	John Fritz mine.
Metallic iron	63.14 to 67.875	61.55 to 69.59
Phosphorus	0.014 to 0.109	.010 to .111
Sulphur	0.021 to 0.158	.032 to .133
Manganese	nil to 0.048	nil to .097
Silica	1.19 to 6.07	0.72 to 3.34
Alumina	0.15 to 2.03	0.26 to 1.09
Lime	0.36 to 0.91	0.29 to 2.79
Magnesia	0.05 to 0.35	0.10 to 1.20

The table below shows the shipments of iron ore from mines in the province of Santiago de Cuba from 1884 to 1905, 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, 1884–1905.

[Long tons.]

Year.	Juragua Iron Co. (Limited).	Sigua Iron Co.	Spanish-American Iron Co.	Cuban Steel Ore Co.	Total.
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
1803	155,898		[d] 467,723		623,621
1904	31,162		[e] 356,111		387,273
1905	139,828		[f] 421,331		561,159
Total	4,238,683	20,438	3,022,283	41,241	7,322,645

[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.
[f] Of this quantity, 1,494 tons were sent to Cuba.

Total....... 88,091 tons sent to foreign ports.

MANGANESE ORES.

By John Birkinbine.

PRODUCTION.

The following report discusses the manganese industry as it affects the United States, and shows that in 1905 there were produced—

	Long tons.
Manganese ores	4,118
Manganiferous iron ores	769,256
Argentiferous manganiferous iron ores	81,738
Manganiferous zinc residuum	90,289

The imports of manganese ores in 1905 were 257,033 long tons, the prominent exporting countries being Brazil, 114,670 tons; India, 103,030 tons, and Russia, 24,650 tons.

There were manufactured in the United States 62,186 long tons of ferromanganese and 227,797 long tons of spiegeleisen.

The imports of ferromanganese in 1905 were 52,841 long tons, and the imports of spiegeleisen were 55,457 long tons.

The production of manganese ores in the United States in the year ending December 31, 1905, was 4,118 long tons, valued at $36,214, or $8.80 per ton, an increase of 972 tons, or 31 per cent over the 1904 total of 3,146 long tons.

The following table gives the production of the various States, the total value, and the average price per ton at the mines for the years 1901 to 1905, inclusive:

Production and value of manganese ores in the United States, 1901–1905, by States.

[Long tons.]

State.	1901.			1902.			1903.		
	Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.
Alabama	17	$111	$6.50						
Arkansas	91	657	7.22	82	$422	$5.15			
California	610	3,610	5.92	846	10,175	12.03	16	$116	$7.25
Georgia	4,074	24,674	6.06	3,500	20,830	5.95	500	2,930	5.86
Missouri	28	280	10.00						
South Carolina				8	40	5.00	25	263	10.52
Tennessee	400	3,287	8.22						
Utah	2,500	31,250	12.50				483	2,415	5.00
Virginia	4,275	52,853	12.36	3,041	29,444	9.68	1,801	19,611	10.89
Total	11,995	116,722	9.73	7,477	60,911	8.15	2,825	25,335	8.97

Production and value of manganese ores in the United States, 1901–1905, by States—Continued.

State.	1904.			1905.		
	Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.
California	60	$900	$15.00	1	[a]$5	$5.00
Georgia				150	[a]900	6.00
Tennessee				[a]20	[a]100	5.00
Utah	32	160	5.00			
Virginia	3,054	28,406	9.30	[b]3,947	35,209	8.92
Total	3,146	29,466	9.37	4,118	36,214	8.80

[a] Estimated. [b] In addition 453 tons of tailings were shipped, valued at $406.

In 1905 only four States mined manganese ores—California, Georgia, Tennessee, and Virginia, the latter being the most important producer; but manganiferous iron ore was obtained in Arkansas, Colorado, and the Lake Superior region.

The following table shows the production of manganese ore in Virginia, Georgia, Arkansas, and other States, together with the total production and the total value, for the years 1880 to 1905, inclusive:

Production of manganese ores in the United States, 1880–1905.

[Long tons; maxima in italics.]

Year.	Virginia.	Georgia.	Arkansas.	Other States.	Total production.	Total value.
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	3,051	None.		92	3,146	29,466
1905	3,947	150		21	4,118	36,214
Total for 26 years	199,869	72,294	49,404	26,032	347,599	3,310,611

It will be seen from this table that the production of manganese ores has not been important in either quantity or value, for most of the manganese ores used in the United States have been imported from foreign countries. The quantity of manganiferous ores produced, however, is much in excess of that of manganese ores, the distinction between the two being practically based upon the manganese ores yielding 40 per cent or more of metallic manganese.

MANGANIFEROUS IRON ORES.

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

Arkansas supplied 3,321 tons of this class of ore, carrying 28 per cent of manganese and 10 to 14 per cent of iron.

Colorado supplied 45,837 tons of manganiferous iron ores, ranging from 14 to 41 per cent of manganese, the average being about 19.5 per cent.

The Lake Superior region produced 720,198 tons of manganiferous iron ores, carrying from 1 to 10 per cent of manganese, some of which were used in the production of spiegeleisen.

The quantities of manganiferous iron ores mined in the United States by States from 1902 to 1905, inclusive, together with the range of the manganese contents, the total value, and the average price per ton are given in the following table:

Production, percentage of manganese, total value, and average price of manganiferous iron ores, 1902–1905.

[Long tons.]

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

Locality.	1904.				1905.			
	Quantity.	Percentage of manganese.	Reported total value at mines.	Average price per ton.	Quantity.	Percentage of manganese.	Reported total value at mines.	Average price per ton.
Arkansas	600	28	$1,200	$2.00	3,321	28	$6,642	$2.00
Colorado	17,074	15 to 32	54,104	3.17	45,837	14 to 41	110,497	2.41
Lake Superior region	365,572	1 to 20	636,173	1.74	720,098	1 to 8	1,437,830	2.00
Total	383,246	1 to 32	691,477	1.80	769,256	1 to 41	1,554,969	2.02

The quantities of this class of ore produced annually from 1900 to 1905, inclusive, the total value, and the average price per ton are set forth in the following table:

Production of manganiferous iron ores in the United States, 1900–1905.

[Long tons; maxima in italics.]

Year.	Quantity.	Value.	Average price per ton.	Year.	Quantity.	Value.	Average price per ton.
1900	377,577	$1,037,314	*$2.75*	1903	584,493	1,571,750	$2.69
1901	574,489	1,475,084	2.57	1904	383,246	691,477	1.80
1902	*901,214*	*2,001,626*	2.22	1905	769,256	1,554,969	2.02

ARGENTIFEROUS MANGANIFEROUS IRON ORES.

In winning the precious metals in Colorado considerable quantities of argentiferous manganiferous iron ore are obtained, which does not carry a sufficient amount of gold and silver to make it valuable on that account, but because of its iron and manganese content is available as a flux in the smelters. This ore has also been considered as an iron ore and included in the iron ore report, but the following table gives the quantity and value of this class of ore reported annually from 1900 to 1905, inclusive:

Production of manganiferous silver ores in the United States, 1900–1905.

[Long tons; maxima in italics.]

Year.	Quantity.	Value.	Average price per ton.	Year.	Quantity.	Value.	Average price per ton.
1900	188,509	$897,068	*$4.76*	1903	179,205	$649,727	$3.63
1901	*228,187*	865,959	3.79	1904	105,278	348,132	3.31
1902	194,132	*908,098*	4.68	1905	81,738	270,299	3.31

MANGANIFEROUS ZINC ORE.

A by-product in the manufacture of zinc from ores obtained in northern New Jersey containing iron and manganese is used in the production of spiegeleisen. In the year 1905 the quantity of this material produced was 90,289 long tons, valued at $1 per ton. The following table gives the quantity of this by-product made during the years 1900 to 1905, inclusive, together with the total value and the average price:

Production of manganiferous zinc ore residuum in the United States, 1900–1905.

[Long tons; maxima in italics.]

Year.	Quantity.	Value.	Average price per ton.	Year.	Quantity.	Value.	Average price per ton.
1900	87,110	$34,844	$0.40	1903	73,264	$73,264	$1.00
1901	52,311	52,311	1.00	1904	68,189	68,189	1.00
1902	65,246	65,246	1.00	1905	*90,289*	*90,289*	1.00

COMBINED PRODUCTION OF MANGANESE ORES AND MANGANIFEROUS ORES.

The total quantity of manganese ores, manganiferous iron ores, argentiferous manganiferous ores, and zinc residuum produced in the United States in the years 1904 and 1905 are given in the following table, together with their total value and average price per ton:

Production of manganese ores and manganiferous ores in the United States in 1904 and 1905.

[Long tons.]

Kind of ore.	1904.			1905.		
	Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.
Manganese ores	3,146	$29,466	$9.37	4,118	$36,214	$8.80
Manganiferous iron ores	383,246	691,477	1.80	709,256	1,554,969	2.02
Manganiferous silver ores	105,278	348,132	3.31	81,738	270,299	3.31
Manganiferous zinc residuum [a]	68,189	68,189	1.00	90,289	20,289	1.00
Total	559,859	1,137,264	2.03	945,401	1,951,771	2.06

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

PRODUCTION OF MANGANESE ORES BY STATES.

ARKANSAS.

There are a number of deposits of manganese ore in this State, principally in the Batesville section, which have been worked in former years for use in the manufacture of steel. This constitutes their chief market, and though moderately rich in manganese the ores contain too much phosphorus; hence these deposits were not worked in the year 1905. Some manganiferous iron ore has been taken from the old dumps in the Batesville district, the ore averaging about 28 per cent manganese and from 10 to 14 per cent iron, the object being to use this ore in a mixture to increase the manganese in the resulting pig iron to over 1 per cent; there were shipped 3,321 long tons of this class of ore in the year 1905. No true manganese ore was mined in 1905. The production of manganese in the Batesville district from 1850 to 1905, inclusive, is shown in the following table:

Production of manganese in the Batesville district of Arkansas from 1850 to 1905, inclusive.

[Long tons; maximum in italics.]

Year.	Authority.	Quantity.	Year.	Authority.	Quantity.
1850 to 1888	Various authorities	16,647	1898	Mineral Resources of the United States.	2,662
1889	Eleventh Census	2,528	1899	do	356
1890	Mineral Resources of the United States.	5,339	1900	do	145
1891	do	1,650	1901	do	91
1892	do	*6,708*	1902	do	82
1893	do	2,180	1903	do	None.
1894	do	1,934	1904	do	None.
1895	do	2,991	1905	do	None.
1896	do	3,421	Total		49,974
1897	do	3,240			

CALIFORNIA.

Small quantities of manganese ore are mined in this State, and used principally in the chlorination works. The quantity reported mined in 1905 was 1 long ton, and the total output from 1874 to 1905, as shown in the following table, was 11,435 long tons:

Total production of manganese ores in California, 1874–1905.

	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	1905	1
1896	284		
1897	484	Total	11,435

COLORADO.

In mining the precious metals, considerable quantities of mineral are obtained which carry manganese and iron, but insufficient silver to make them valuable solely on the latter account. Some of this ore, sufficiently high in manganese, is used in the production of spiegeleisen and the remainder as a flux by the smelters. In the year 1905 the quantity supplied for the manufacture of spiegeleisen was 45,837 tons, and 81,738 tons was used as a flux by the smelters.

The following table gives the quantities of the two classes of manganiferous ores mentioned which have been mined in Colorado from 1889 to 1905, inclusive:

Production of manganiferous ores in Colorado, 1889–1905.

[Long tons.]

Year.	Manganiferous iron ores used for producing spiegeleisen.	Manganiferous silver ores.	Total.	Year.	Manganiferous iron ores used for producing spiegeleisen.	Manganiferous silver ores.	Total.
1889	2,075	64,987	67,062	1898	18,848	99,651	118,499
1890	....	51,840	51,840	1899	29,355	79,855	109,210
1891	964	79,511	80,475	1900	43,303	188,509	231,812
1892	3,100	62,309	65,409	1901	62,385	228,187	290,572
1893	5,766	54,462	60,228	1902	13,275	194,132	207,407
1894	7,022	30,187	37,209	1903	14,856	179,205	194,061
1895	13,464	53,506	66,970	1904	17,074	105,278	122,352
1896	9,072	137,597	146,669	1905	45,837	81,738	127,575
1897	16,519	149,502	166,021				

GEORGIA.

The deposits of manganese ores in this State were not worked in 1904, but produced 150 long tons in 1905, making the total mined in the State from 1866 to 1905, inclusive, 92,244 tons, as will be seen from the following table:

Production of manganese ores in Georgia, 1866–1905.

	Long tons.		Long tons.
From 1866 to 1873 (estimated)	5,550	1891	3,575
1874	2,400	1892	826
1875	2,400	1893	724
1876	2,400	1894	1,277
1877	2,400	1895	3,856
1878	2,400	1896	4,085
1879	2,400	1897	3,332
1880	1,800	1898	6,689
1881	1,200	1899	3,089
1882	1,000	1900	3,447
1883 and 1884	(a)	1901	4,074
1885	2,580	1902	3,500
1886	6,041	1903	500
1887	9,024	1904	......
1888	5,568	1905	150
1889	5,208		
1890	749	Total	92,244

TENNESSEE.

Manganese ores have been mined intermittently in this State, and the 20 tons produced in 1905 was a sample car load.

VIRGINIA.

Virginia has been the most prominent producer of manganese ores in the United States, and with but six exceptions has ranked first for the last twenty-six years. In 1905 the quantity mined was 3,947 tons, making the total output for the last twenty-six years 199,869 long tons.

The following table gives the production of manganese ores in the State of Virginia from 1880 to 1905, inclusive:

Production of manganese ores in Virginia, 1880–1905.

	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	1905	3,947
1896	2,018		
1897	3,650	Total	199,869

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

IMPORTS OF MANGANESE ORES.

The large demand for ferromanganese and spiegeleisen, which are used in the manufacture of steel, is met by the production of these metals from ores obtained in foreign countries or by the importation of the metals themselves. The quantity of

a None reported.

manganese ores imported in the year 1905, according to the Bureau of Statistics of the Department of Commerce and Labor, was 257,033 long tons, valued at $1,952,407, or $7.60 per ton, as against 108,519 tons, valued at $901,592, or $8.38 per ton, brought in in the year 1904. The quantity imported in the year 1905 was the largest recorded, slightly exceeding the previous maximum of 256,252 long tons in the year 1900.

Brazil contributed the largest imports in 1905, 114,670 long tons; India was next, with 101,030 long tons, Russia, Cuba, Germany, Japan, and the United Kingdom following in the order named. The inference from the high valuations placed on the ores from some foreign countries is that they were imported for special chemical purposes.

The following table, prepared by the Bureau of Statistics (as are the other tables of imports and exports), shows the quantity of manganese ores brought into the United States, by countries, from the year 1903 to 1905, inclusive:

Imports of manganese ores into the United States during the calendar years 1903, 1904, and 1905, by countries.

[Long tons.]

Country.	1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Brazil	76,910	$738,885	66,875	$589,089	114,670	$1,058,478
Russia, Black Sea	1,596	15,565	11,959	98,002	21,350	175,633
Russia, Baltic and White seas	3,980	39,800			3,300	27,141
British East Indies	35,960	226,796	10,200	58,635	101,030	501,423
Cuba	17,721	111,670	16,239	80,974	6,489	35,049
Chile	3,451	25,555				
Japan	400	10,593	996	12,651	1,329	13,950
Germany	2,837	77,985	1,031	33,365	2,336	54,150
United Kingdom	893	23,138	993	22,533	1,298	30,555
Quebec, Ontario, etc	3	303	1	63		
Nova Scotia, New Brunswick, etc	35	1,395	117	3,824	7	575
Austria-Hungary	1	35				
Spain	2,244	5,836			50	708
Belgium	25	552	108	2,456	80	1,762
All other countries					5,094	52,983
Total	146,056	1,278,108	108,519	901,592	257,033	1,952,407

Nearly one-half of the manganese ores imported in the year 1905 was entered at the port of Baltimore, which was closely followed by Philadelphia, these two cities receiving 243,609 long tons, or 95 per cent of the total. The remainder was received at Mobile, New York, Pensacola, etc.

The imports of manganese ores by customs districts from 1903 to 1905, inclusive, together with the value of the ores, are given in the accompanying table.

Manganese ores imported into the United States during the calendar years 1903, 1904, and 1905, by customs districts.

[Long tons.]

Customs districts.	1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Philadelphia, Pa	933	$25,600	33,651	$294,408	117,591	$822,525
Baltimore, Md	115,701	999,835	49,876	422,453	126,018	993,163
New York, N. Y	3,893	72,091	4,833	65,450	5,954	90,942
Perth Amboy, N. J	2,244	5,836				
Pittsburg, Pa	17	1,459				
Newport News, Va	613	18,332	83	2,102		
Chicago, Ill	153	6,397	184	6,140	20	496
Boston, Mass	6	408	3	195	4	127
New Orleans, La	4,750	34,170			199	1,822
Pensacola, Fla					650	4,284
Mobile, Ala	17,721	111,670	19,844	109,564	6,489	35,049
Huron, Mich	3	303	1	63		
All others	22	2,007	44	1,217	108	3,999
Total	146,056	1,278,108	108,519	901,592	257,033	1,952,407

The dependence of the United States on foreign countries as the source of its manganese ore supply is shown by the following table, which gives the relative quantities and values of manganese ores produced in this country and the quantities and values of the importations for the years 1889 to 1905, inclusive.

This indicates that in the seventeen years ending December 31, 1905, the average annual production of manganese ores in the United States was 11,700 long tons, valued at $105,116, while the average amount imported during the same period was 114,621 long tons, valued at $1,009,443.

Relative quantities and values of domestic and imported manganese ores, 1889–1905.

[Long tons.]

Year.	Domestic production.		Imports.	
	Quantity	Value.	Quantity.	Value.
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
1905	4,118	36,214	257,033	1,952,407
Total for 17 years	198,903	1,786,974	1,948,558	17,160,539
Average for 17 years	11,700	105,116	114,621	1,009,443

PRICES OF MANGANESE ORES.

Owing to the demand for ferromanganese and spiegeleisen, the requirements of the steel manufacturers in the ores which are used to produce these metals has been slightly modified, particularly in the reduction of the phosphorus minimum, and the following price list, which was issued in the latter part of December, 1905, will give the present basis:

Prices are placed on ores delivered in the Pittsburg, Pa., and Chicago, Ill., districts, per long ton, containing not more than 8 per cent silica and not more than 0.25 per cent phosphorus, and are subject to deductions as follows:

For each 1 per cent in excess of 8 per cent silica there shall be a deduction of 15 cents per ton, fractions in proportion; for each 0.02 per cent or fraction thereof in excess of 0.25 per cent phosphorus there shall be a deduction of 2 cents per unit of manganese per ton.

	Prices per unit.	
	Iron.	Manganese.
Metallic manganese ore containing above—	*Cents.*	*Cents.*
49 per cent	6	30
46 to 49 per cent	6	29
43 to 46 per cent	6	28
40 to 43 per cent	6	27

NOTE.—Ore containing less than 40 per cent manganese or more than 12 per cent silica or 0.27 per cent phosphorus, subject to acceptance or refusal, buyer's option.

Settlements are based on analysis of sample dried at 212° F., the percentage of moisture in the sample as taken being deducted from the weight.

Prices subject to change without notice, unless otherwise specially agreed upon.

PRODUCTION OF DOMESTIC AND IMPORTATIONS OF FOREIGN FERROMANGANESE AND SPIEGELEISEN.

In the production of steel, varying proportions of ferromanganese or spiegeleisen is used, depending on the character of the product desired and the process used, and to supply this need the bulk of the manganese ore imported as well as the domestic ores are smelted to produce "ferro" or "spiegel," and liberal quantities of these metals are also imported. The American Iron and Steel Association gives the production of ferromanganese and spiegeleisen in the United States, in the calendar year 1905 as 289,983 long tons, of which 62,186 tons was ferromanganese and 227,797 tons spiegeleisen, and the imports were respectively 52,841 and 55,457 long tons, a total of 398,281 long tons.

The following table gives the production of domestic ferromanganese and spiegeleisen for the years 1893 to 1905, inclusive, that for the year 1905 being next to the maximum of 291,461 long tons in the year 1901.

Production of domestic spiegeleisen and ferromanganese, calendar years 1893–1905.

	Long tons.		Long tons.
1893	81,118	1900	255,977
1894	120,180	1901	291,461
1895	171,724	1902	212,981
1896	131,940	1903	192,661
1897	173,695	1904	219,446
1898	213,769	1905	289,983
1899	219,768		

During the year the prices secured for ferromanganese and spiegeleisen were inviting compared to former years, and but 41,166 long tons of ferromanganese and 22,443 tons of spiegeleisen were imported in the fiscal year ending June 30, 1905, due to the scarcity of these metals caused by the augmented demand not only in this but in foreign countries. As to the manganese content, it is probable that the greater proportion of ferromanganese to spiegeleisen in 1905 makes it run below the years 1903 and 1902 only.

The following table gives the importations of ferromanganese and spiegeleisen for the fiscal years 1900 to 1905, inclusive, together with the total value:

Imports of ferromanganese and spiegeleisen for fiscal years ending June 30, 1900–1905.

[Long tons.]

Year.	Ferromanganese.	Spiegeleisen.	Total.	
	Quantity.	Quantity.	Quantity.	Value.
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
1905	41,166	22,443	63,609	1,877,606

PRODUCTION OF MANGANESE IN FOREIGN COUNTRIES.

As the quantity of manganese ore mined in the United States is comparatively small while the consumption is large, brief mention will be made of the various foreign countries producing manganese ores, the three principal contributors to the United States being dealt with at some length.

CANADA.

Small quantities of manganese ore are mined 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 exports of manganese ore in 1905 as 22 short tons, valued at $1,720.

The accompanying table gives the exports of manganese ore from Canada for the years 1900 to 1905, inclusive, which practically covers the production of the ore, as only a small quantity has been smelted in the Dominion, and none in the last few years.

Exports of manganese ore from Canada, 1900–1905.

[Short tons.]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1900	34	$1,720	1903	135	$1,889
1901	440	4,820	1904	123	2,706
1902	172	4,062	1905	22	1,720

CUBA.

The exploited manganese mines of Cuba are situated in the Province of Santiago de Cuba, in the southeastern portion of the island, and in October, 1905, the last importation was received from the Ponupo Mining and Transportation Company, operations having been suspended since that time. The total exports for the year 1905 were 6,907 long tons.

The exportation of manganese ore from the Santiago district of Cuba for the years 1900 to 1905, inclusive, is as follows:

Exports of manganese ore from Santiago district, Cuba, 1900–1905.

	Long tons.		Long tons.
1900	22,600	1903	18,795
1901	25,183	1904	15,516
1902	39,628	1905	6,907

BRAZIL.

Manganese ores are reported as being widely distributed in Brazil, occurring in the States of Minas Geraes, Bahia, Matto Grosso, Parana, and Santa Catharina. The deposits extensively worked are in the State of Minas Geraes, small quantities only having been shipped from the Bahia mines.

The Minas Geraes manganese ores occur in the mining zone of that State which is traversed by the Central Railway system entering the district at Lafayette, 465 kilometers from Rio, where the gage of the line is reduced from 1 meter 60 centimeters to 1 meter.

The deposits may be divided according to Mr. Herbert Kilburn Scott,[a] into—

(1) Those near the branch line to Ouro Preto on the Central Railway system, and about 500 kilometers from Rio, where the manganese ore is found in a bedded deposit associated with an iron schist formation known as Itabirite. The average thickness of the ore body is reported as 2 meters, and its length as something like 6 kilometers.

(2) Those near the towns of Lafayette and Queluz, where the mineral is said to occur in lenses varying in size from a few meters to a hundred or more. The inclosing rocks are micaceous schists and gneisses.

The average cargo analyses of the two types of ore are as follows:

Analysis of Ouro Preto branch line manganese deposits.

(Dried at 100° C.)

	Per cent.
Metallic manganese	53.00
Silica	1.00
Phosphorus	.03

Analysis of Lafayette or Queluz manganese deposits.

(Dried at 100° C.)

	Per cent.
Metallic manganese	47.00 to 50.00
Silica	3.00 to 6.00
Phosphorus	.08 to .12

The moisture in the Ouro Preto branch line ores is over 15 per cent, and that of the Lafayette ores from 3 to 5 per cent.

During the last three years the expansion of the industry has not been so marked as heretofore, due in a great measure to the limited transportation facilities of the Central Railway.

In 1904 the Morra da Mina deposit commenced large shipments with the result that the insufficiency of the railway became more pronounced.

During the year 1905 the profits made by the mine operators were said to be satisfactory notwithstanding the low price, 9 pence to 9½ pence per unit of metallic manganese—cost, insurance, freight European or North American ports. The wide-gage line was continued beyond Lafayette for some 20 kilometers in order to allow of the ore in that district being loaded direct into wide-gage cars.

With the beginning of the year 1905 the economic conditions for manganese ore mining were reported brighter, this being due to some extent to the cessation of shipments from the Russian deposits because of internal troubles of the Caucasus district, but principally by reason of the better trade conditions of the United States.

[a] Personal correspondence.

Prices of the mineral rose from the figures given above to 11 and 12 pence per unit of metallic manganese. This difference was not all profit, because of the increased cost of production due to a simultaneous rise in exchange of about 40 per cent—from 12 pence to 17 pence per milreis.

The sliding scale on which the railway rate is calculated only operates to 12 pence, so that a rise above that figure increases the freight in gold appreciably. The mine operators are agitating to have the rate based on a sliding scale for the higher level of exchange, and there is a possibility of their being successful when the new Government comes into power in November, 1906.

During 1905 one of the large manganese ore deposits, known as Piquiry, suspended shipments owing to the merchantable ore in the deposit having given place to manganese garnet rock from which it was derived.

Mr. Scott says:

The Usina Wigg, the principal mine operator in the Ouro Petro branch line deposits, commenced last year the erection of a plant for briqueting the finely divided ore after reducing its moisture contents. The installation, it is said, will have a capacity of 100 tons briquets per day. The binding material will be furnished by a proportion of the moisture left in the ore after reducing it to the size of $1\frac{1}{2}$ millimeters. The presses will work with a pressure of 10 tons per square inch and the briquets will weigh 800 grams each. Experimental briquets are reported to resist shock and high temperature without disintegrating.

No important discovery of ore deposits has been made during the last three years, but the reserves in the Usina Wigg and Morra da Mina properties are stated to be so large (over 7,000,000 tons), that the output is guaranteed for many years.

As soon as the difficulties of railway transportation are overcome the output may be raised to 300,000 tons per annum.

The future of the industry is reported bright, as the mine operators hope to have the railway freight reduced, and the conclusion in the near future of the Rio port works will enable the ore to be shipped at a fraction of the present cost.

In the tables following the shipments to Rio de Janerio by firms and the exports to consumers by countries prior to 1900 and for the years 1900 to 1905, inclusive, are given.

Shipments of Minas Geraes manganese ores to Rio de Janeiro, by firms.

[Metric tons.]

Year.	I.	II.	III.	IV.	V.	VI.	VII.	Total.
Before 1900	74,690			50,900				125,590
1900	60,111		26,658	28,602	4,393			119,764
1901	21,365		25,309	2,042	47,553			96,269
1902	47,517	5,376	64,747		45,439			163,079
1903	38,702	61,306	52,769		42,719			195,496
1904	45,684	59,502	52,461		58,808			216,455
1905	48,780	57,200	15,880		56,200	9,600	5,200	192,860
Total	336,849	183,384	237,824	81,544	255,112	9,600	5,200	1,109,513

I. Usina Wigg, operating the Miguel Burnier mine, commenced work 1892.

II. Morra da Mina Company, operating the Piquiry mine, commenced work 1902.

III. G. Ramos & Co., operating the Piquiry mine, commenced work 1896.

IV. G. Ramos & Co., operating the Burnier mine, commenced work 1896.

V. La Société des Mines de Manganese de Ouro Preto, operating the Sao Goncalo mine, commenced work 1900.

VI. Mineracao do Brazil Company, operating the Ferreira mine, commenced work 1905.

VII. Companhia Queluz de Minas, commenced work 1905.

Shipments of Minas Geraes manganese ores to consumers, by countries.

[Long tons.]

Year.	United Kingdom and Europe.	United States.	Total.
Before 1900	....	....	125,620
1900	75,900	51,438	127,338
1901	56,171	48,030	104,201
1902	41,170	103,199	144,369
1903	91,819	76,910	168,729
1904	99,590	85,820	185,410
1905	134,200	99,750	233,950
Total	498,850	465,147	1,089,617

The total quantity of manganese ore shipped from the State of Bahia is equal to 41,100 metric tons, distributed over the last eight years.

CHILE.

Chile contains many deposits of manganese ores, the exploited mines being situated in the provinces of Atacama and Santiago, the ore mined being exported, the quantity forwarded in 1903 being 17,110 metric tons.

The accompanying table gives the export of Chilean manganese ores for the years 1900 to 1903, inclusive, with the value in one of the years:

Exports of Chilean manganese ores, 1900–1903.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Metric tons.			*Metric tons.*	
1900	25,715	....	1902	[a] 12,990	$142,241
1901	31,477	....	1903	17,110	....

[a] From Coquimbo.

GREAT BRITAIN.

The United Kingdom does not produce true manganese ores, but some manganiferous iron ore is won, the quantity obtained in 1904 being 8,756 tons, valued at £4,370, the largest total since 1891. This mineral was reported won in the following districts:

Production of manganiferous iron ores in the United Kingdom in 1904.

District.	Quantity.	Value at mines.
	Long tons.	
Derby	50	£25
Devon	177	142
Merioneth	282	209
Carnarvon	8,247	3,904
	8,756	4,370

The production and value of manganiferous iron ores in the United Kingdom from 1900 to 1904 is as follows:

Production and value of manganiferous iron ores in the United Kingdom, 1900–1904.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Long tons.			*Long tons.*	
1900	1,362	$3,285	1903	818	$3,191
1901	1,646	....	1904	8,756	21,267
1902	1,278	3,319			

BELGIUM.

Some manganiferous iron ore is obtained in Belgium, but the quantity has decreased in late years, until in 1904 only 485 metric tons were reported.

The following table gives the production of manganiferous iron ores in Belgium from 1900 to 1904, inclusive:

Production of manganiferous iron ores in Belgium, 1900–1904.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Metric tons.			*Metric tons.*	
1900	10,820	$25,158	1903	6,100	$14,668
1901	8,510	21,384	1904	485	849
1902	14,440	36,149			

FRANCE.

According to the statistics of the Comité des Forges de France there were mined in that country, in the year 1904, 11,254 metric tons of manganese ores, valued at 283,134 francs ($54,645), obtained from 6 mines, the greater portion of the mineral being obtained from the mines of Romanèche and Grand-Filon, in the Department of Saône-et-Loire.

The following table gives the total production, total value, and average price per ton of the manganese ore obtained in France from 1900 to 1904, inclusive.

Production and value of manganese ores in France, 1900–1904.

Year.	Quantity.	Value.	Price per ton.
	Metric tons.		
1900	28,992	$164,050	$5.66
1901	22,304	91,699	4.11
1902	12,536	63,227	5.04
1903	11,583	56,742	4.90
1904	11,254	54,645	4.86

GERMANY.

There were mined in the German Empire, in the year 1904, 52,886 metric tons of manganiferous ores, valued at 591,000 marks ($140,658); of this amount 52,092 metric tons, valued at 549,863 marks ($130,868), were obtained in Prussia.

The annual production of manganese ores in Germany from 1900 to 1904, and in Prussia from 1900 to 1904, inclusive, together with the value of the latter is given in the accompanying tables:

Production of manganese ores in Germany, 1900–1904.

	Metric tons.
1900	59,204
1901	56,691
1902	49,812
1903	47,994
1904	52,886

Production and value of manganese ores in Prussia, 1900–1904.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Metric tons.			*Metric tons.*	
1900	58,014	$157,271	1903	47,110	$110,194
1901	55,863	155,652	1904	52,092	130,868
1902	48,882	126,140			

ITALY.

The Kingdom of Italy in the year 1904 mined 2,836 metric tons of manganese ore, valued at 86,630 lire ($16,720), being obtained from 7 mines. No manganiferous iron ore was reported produced.

The following table gives the annual production of manganese and manganiferous iron ores from 1900 to 1904, inclusive, together with the value of the same:

Production and value of manganese and manganiferous iron ores in Italy, 1900–1904.

[Metric tons.]

Year.	Manganese ores.		Manganiferous iron ores.	
	Quantity.	Value.	Quantity.	Value.
1900	6,014	$29,910	26,800	$64,655
1901	2,181	16,052	24,290	58,131
1902	2,477	20,022	23,113	53,384
1903	1,930	11,319	4,735	11,332
1904	2,836	16,720	....	....

SPAIN.

Manganese ores of the carbonate and silicate varieties are mined in the Province of Huelva, and exported. Mr. Carl Doetsch, of Huelva, states that the quantity exported in the year 1904 was 26,895 metric tons, and has furnished the following table giving the total exports from the Province of Huelva for the years 1859 to 1904, inclusive:

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

	Metric tons.		Metric tons.
1859-1900	1,107,898	1904	26,895
1901	91,672	Total	1,343,949
1902	62,944		
1903	54,540		

Most of this ore is sent to Belgium, smaller quantities being shipped to France, England, and Germany, as will be seen from the following table, which gives the quantities shipped to the different countries from 1900 to 1904, inclusive:

Exports of Huelva manganese ores, 1900–1904.

[Metric tons.]

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

PORTUGAL.

In the year 1903 there were produced 30 metric tons of manganese ore valued at 240 milreis ($259).

AUSTRIA-HUNGARY.

Dr. Hans Hofer, of Loeben, Austria, gives the production of manganese ore in Austria in the year 1905 as 13,788 metric tons, valued at 220,461 crowns ($44,754).

The table shows the production of manganese ores in Austria from 1900 to 1905, inclusive:

Production of manganese ore in Austria, 1900–1905.

	Metric tons.		Metric tons.
1900	8,804	1903	6,179
1901	7,796	1904	10,189
1902	5,646	1905	13,788

Doctor Hofer gives the production of manganese ores in Hungary in the year 1904 as 11,527 metric tons, valued at 123,900 crowns ($25,152), and in Bosnia and Herzegovina in 1905 as 4,129 metric tons, valued at 87,393 crowns ($17,741).

The following tables give the quantities of manganese ore mined in Hungary from 1900 to 1904, and in Bosnia and Herzegovina to 1905, inclusive:

Production of manganese ore in Hungary, 1900–1904.

	Metric tons		Metric tons.
1900	5,746	1903	12,490
1901	4,591	1904	11,527
1902	7,347		

Production of manganese ore in Bosnia and Herzegovina, 1900–1905.

	Metric tons.		Metric tons.
1900	7,938	1903	4,537
1901	6,346	1904	1,114
1902	5,760	1905	4,129

RUSSIA.

The most important manganese-ore-producing country is the Russian Empire, the major portion coming from the Caucasus district, where these ores occur as bedded deposits, lying almost horizontally near the tops of the lofty hills, at an altitude of 1,000 feet above the Kvrilli River. The existing beds, as opened on seven mountains near the village of Chiaturi, are reported to have an average thickness of 6 to 7 feet. The ore is chiefly pyrolusite, but other oxides of manganese also occur. It is claimed that an area of more than 22 square miles of the present surface is underlain by ore available for mining. In some localities the materials composing the bed, without sorting or cleaning, carry 50 per cent of manganese, the average being probably 40 to 45 per cent.

A complete analysis of a sample of well assorted and cleaned ore from Chiaturi, dried at 212° F., gave:

Analysis of Chiaturi manganese ore.

Manganese peroxide	86.25	Potash and soda	0.22
Manganese protoxide	.47	Silica	3.85
Iron peroxide	.61	Carbonic acid	.63
Oxide of copper	.01	Sulphur	.23
Oxide of nickel	.30	Phosphoric acid (0.141 P.)	.323
Alumina	1.74	Combined water	1.850
Lime	1.73		
Magnesia	.20	Total	99.953
Baryta	1.54	Metallic manganese	54.90

The average cargos show a smaller yield.

The physical characteristics of the manganese ores of Chiaturi are unfavorable, in that the proportion of large pieces obtained is small, much of the ore being soft and grinding to a fine powder during the handling in mining, cleaning, and transportation. An objection to the Caucasian ore is carelessness in cleaning.

The ore from the Chiaturi mines is sent to Poti and Batoum, the former receiving the bulk of the shipments. It is 108 miles from Chiaturi to the pier at Poti. In addition, the first section of the road from Chiaturi to Sharopan is narrow gauge, necessitating a transfer to broad-gauge cars. This and the high freight rates have restricted the development of the district.

Manganese ore is obtained also from the Nicopol district, analyses of 3,000 tons averaging as follows:

Average of analyses of manganese ore from Nicopol district, Russia.

Manganese	46.00	Moisture	7.00
Metallic iron	1.00	Phosphorus	.25
Silica	12.50		

Most of the ore is exported, the principal consumers being Great Britain, followed by Germany, France, and the United States, etc.

Through the courtesy of Mr. Adolphe Wolski, engineer of mines, department of mineral finance, St. Petersburg, Russia, the following official table is presented, showing the production of manganese ores in Russia by districts from 1885 to 1905, inclusive, together with the exports:

Statistics of manganese ores in the Russian Empire, 1885–1905.

[Poods of 36.113 pounds; 63 poods per long ton.]

Year.	Production.				Exports.	
	Ural.	Southern Russia.	Caucasus.	Total.	Caucasus.	Total.
1885	54,700	....	3,630,700	3,685,400	2,567,000	2,567,000
1886	50,200	220,500	4,215,100	4,485,800	3,286,975	3,403,000
1887	51,300	226,350	3,217,185	3,494,835	3,732,435	3,810,000
1888	82,700	89,600	1,822,834	1,995,134	3,042,715	3,055,000
1889	179,100	341,500	4,243,237	4,783,837	3,229,037	3,280,000
1890	143,500	528,100	10,468,105	11,139,705	8,129,480	8,235,000
1891	118,200	660,300	6,099,012	6,877,512	4,543,905	4,575,000
1892	56,300	1,795,100	10,236,244	12,087,644	7,875,792	7,876,000
1893	186,100	4,740,200	10,318,039	15,244,339	7,633,443	7,656,000
1894	108,400	3,562,150	11,117,536	14,788,086	8,960,494	8,965,000
1895	168,200	2,286,635	7,208,649	9,663,484	10,180,770	10,202,000
1896	249,500	2,782,841	9,706,288	12,738,629	8,807,645	8,842,000
1897	302,833	3,417,125	12,131,807	15,851,765	10,743,192	11,441,000
1898	396,243	3,640,475	16,259,204	20,295,922	14,468,282	14,950,000
1899	115,587	5,914,828	34,052,442	40,082,857	22,433,519	25,336,000
1900	174,886	5,407,860	40,363,492	45,946,238	26,335,531	26,914,798
1901	215,700	4,243,514	22,904,535	27,363,749	18,860,179	19,509,000
1902	375,581	3,503,920	25,925,115	29,804,616	27,104,433	27,498,734
1903	287,000	2,091,547	22,974,603	25,353,150	27,173,208	28,003,816
1904	[a] 300,000	3,693,122	21,711,309	25,704,431	[a] 28,950,000	29,609,000
1905	[a] 300,000	7,139,624	19,034,538	[b] 26,474,162	....	21,833,000

[a] By approximation. [b] 426,813 long tons.

SWEDEN.

The production of manganese ore in Sweden in the year 1904 was 2,297 metric tons, valued at 35,500 kroners ($9,514).

The following table gives the statistics of the production and value of manganese ore in Sweden for the years 1900 to 1904, inclusive:

Production of manganese ore in Sweden, 1900–1904.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Metric tons.			*Metric tons.*	
1900	2,651	$13,179	1903	2,244	$9,795
1901	2,271	11,256	1904	2,297	9,514
1902	2,850	14,729			

NORWAY.

It is stated that in the year 1904 the quantity of manganese ore mined in Norway was 22 metric tons, valued at 1,000 kroners ($268).

TURKEY.

Good deposits of manganese ore are found in Turkey, but no official statistics are kept, all of the ore mined being exported. Mr. Hugh Whittall, of Constantinople, states that the ministry of mines reported the exportation of manganese ore from Turkey in the year 1904 as 49,100 tons.

GREECE.

Moderate quantities of manganese ore are exported from Greece, the quantity mined in 1903 being reported as 9,340 metric tons, valued at 280,200 francs ($54,079), and in 1904, 7,355 metric tons, valued at 220,650 francs ($42,585). Considerable quantities of manganiferous iron ores are also mined.

INDIA.

Mr. T. H. Holland, director of the geological survey of India, says[a] that on account of the richness and purity of the manganese bodies opened up in the central provinces the production rapidly increased in spite of the handicap of a railway transportation of 500 to 600 miles. The recent discovery of deposits in the Bombay Presidency nearer the coast will probably result in a still further expansion of the export trade, as all of the ore is sent to various foreign countries.

In the central provinces, where mining is most active, the principal occurrences are in the Ramtek tahsil of the Nagpur district, where in some 17 different villages quarrying operations are carried on. In the northwestern part of the Bhandara district there are 14 localities known to contain manganese ore, and a certain amount of work is in progress. In the Balaghat district 10 occurrences are known in the west of the district, while mining is being carried on near the town of Balaghat and at another large deposit at Ukua in the Behir tahsil. In Chhindwara manganese ore has long been known near Gosalpur and Sihora in the Jabalpur district. The ore is also reported in the Khairagarh and Kalahandi states.

Mr. L. Leigh Fermor, deputy superintendent geological survey of India, in "Notes on the Petrology and Manganese Ore Deposits of the Sausar Tahsil, Chhindwara District, Central Provinces,"[b] says:

Turning to the manganese-bearing rocks it must be said that the types occur in lenticles and lenticular drawn-out bands of any thickness up to 50 feet or over (as at Kachi Dhána), while as regards length one band (at Wagora) has been traced at intervals for a mile.[c] These bands have the same strike and dip as the gneisses and schists between which they are intercolated; the manganese ores probably result, in part at least, from the chemical alteration of the various manganese silicates. The evidence shows that this change is one of great antiquity, and is not, at least to any appreciable extent, going on now.

Mr. Datta, in his 1893–94 survey of this area, discovered the deposit of Kachi Dhána, and also found indications of that of Gowári Warhona. Subsequently, in the year 1903, the late Mr. A. M. Gow Smith independently found 11 deposits. Owing to their distance (30 to 50 miles) from the railway, none of these deposits have yet been opened. Of these, Mr. Fermor states that only those at Kachi Dhána and Gowári Warhona are most certainly worth working, as is probably also Sitapár. Those at Lakhanwára and Gaimukh will need some development work before a definite opinion can be expressed, while the remainder, with the possible exception of that at Ghoti, can be condemned at once as not having value under present conditions.

This Kachi Dhána is undoubtedly the largest and most valuable deposit in the district. There are five separate ore hillocks, arranged along an east-west line, of which the largest is about 360 paces long, 130 broad, and, say, 40 feet high. As far as can be estimated, without clearing away the thick jungle which covers the hill and opening up the deposit, the ore body will probably be found to be from 50 to 100 feet wide. The ore varies slightly in character in the different hillocks, and is either a fine to medium grained mixture of *Psilomelane* and *Braunite*, in which the latter is the predominant constituent, or is finely crystalline braunite with fairly numerous black spots.

In the season of 1893-4 Mr. Datta found indications of the Gowári Warhona deposit in the shape of pieces of ore scattered on the surface. Then, in 1903, the late Mr. Gow Smith opened up a series of trial pits exposing a stratum of good manganese ore occurring in biotitic schists and acid gneisses.

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[a] Rec. Geol. Survey India, vol. 32, pt. 1, 1905.

[b] Rec. Geol. Survey India, vol. 33, pt. 3, 1906, pp. 172-173, 207-214.

[c] In other districts of the Central Provinces much larger dimensions have been measured for the bodies of manganese-bearing rock.

The ore stratum is 5½ to 6 feet thick, dipping at 50° to the south 30° west, and is well exposed in two rivulets, where it very closely simulates a coal outcrop, the ore being "bedded" or laminated in layers 1 to 4 inches thick. The total length of merchantable ore exposed is about one-fourth of a mile; outside these limits the band becomes, to the southeast, rich in *spessartite* and *quartz*, and in both directions is probably cut off by faults bringing in calciphyres and limestones.

The Sitapar ore deposit takes the form of a small elliptical hillock, 27 paces long from east to west by 23 broad, and perhaps 20 to 25 feet high. Since it rises from the middle of a field, it may be found to be of much greater extent on removing the surrounding alluvial soil. The whole outcrop consists of huge blocks containing a variety of manganese minerals.

Situated 200 to 250 yards west of the Gaimukh ore body the Lakhanwára deposit is only visible at the surface as three very small outcrops of rather fine-grained, hard, gray crystalline ore, which is probably the best quality braunite.

The outcrop of the Gaimukh ore body is of lenticular shape, about 60 paces long and 26 broad, the lens being orientated east and west. The ore, which is mostly *braunite*, with some *rodochrosite*, has probably been derived from a rock consisting largely of *spessartite* of orange-yellow color, and of *rhodonite*, but it is only the central portion of the outcrop, about 20 yards long and 7 broad, which has undergone sufficient alteration to be workable as a source of ore.

The following table gives analyses of Chhindwara, India, maganese ores:

Analyses of Chhindwara manganese ores.

	Kachi Dhána ores.				Gowári Warhona ores.		
	(1)	(2)[a]	(3)[a]	(4)[a]	(1)	(2)	(3)
Manganese	54.73	53.25	53.05 to 56.82	51.87	53.59	51.82 to 56.45	47.45
Iron	5.00	....	2.82 to 5.30	4.92	5.00	1.31 to 3.83	3.55
Silica	6.99	....	1.10 to 9.02	16.27	6.21	1.45 to 10.1	13.65
Phosphorus	.07	.91	.004 to .135	.033	.07	.03 to .09	.122
Moisture (at 100° C.)	.17	.26	....	....	.31	....	....

	Sitapar ores.			Lakhanwára ores.	
	(1)	(2)	(3)	(1)	(2)[a]
Manganese	54.97	54.94	53.90	50.41	57.51
Iron	6.89	5.28	6.10	11.77	6.02
Silica	6.95	7.33	8.37	4.86	4.63
Phosphorus	.06	,072	.055	.20	.153
Moisture (at 100° C.)	....	....	....	.39	....

	Gaimukh ores.			Ghoti ores.		
	(1)	(2)[a]	(3)	(1)	(2)[a]	(3)
Manganese	54.98	56.68	54.20	49.55	48.62	49.48
Iron	6.19	6.21	5.00	7.71	8.17	8.25
Silica	10.63	7.68	9.75	8.74	6.28	4.60
Phosphorus	.04	.078	.036	.28	.276	.306
Moisture (at 100° C.)	.32	....	....	.52	....	....

[a] At 212° F.

The deposits in the central provinces belong to the same group of rocks which farther to the southeast were first worked for manganese ore in the Vizianagram state, and the intermediate jungle-covered country, which is very little known, will possibly show other occurrences of ore on more systematic exploration. In other parts of the Madras Presidency the ore has been reported in the Kallikota state in the Ganjam district and in the Sandur hills of Bellary.

One occurrence has been recorded in the Gwalior state, and one deposit is now being worked in Jhabua from which 6,800 tons were mined in 1903. There are several localities at which poor ores are found in the Dhar forest.

On the Bombay side manganese ore has been found at several places around Mahabaleshwar and Satara, in the southern part of Belgaum district, in Bijapur, near Jambughora in Rewa Kantha, and in the Dharwar district, where prospecting operations are in progress. If the deposits in Dharwar and Belgaum approach those in the central provinces they will, on account of their proximity to the coast, develop rapidly. Manganese ore has been reported also in the Tavoy and Mergin districts of South Burma, in the Nizam's dominions, and in the form of manganiferous iron ore near Chaibassa in the Chota Nagpur.

In the Nagpur area the manganese ore occurs as lenticular masses and bands in the quartzites, schists, and gneisses.

The ore bodies often attain great dimensions, and their deposition as irregular lenses along the strike of the inclosing schists influences the miner in laying out his claims. A deposit near Balaghat is 1¾ miles long; at Manegaon in the Nagpur district the ore body is 1½ miles long; and at Thiroi in the Balaghat district it is nearly 6 miles long. As examples of great width Mr. Holland quotes Kandri 100 feet thick of pure ore, and Ramdongri, 1,500 feet of ore and unaltered spessarite rock. The depth of the ore bodies is unknown.

The Nagpur ore is a mixture of braunite and psilomalene, sometimes entirely braunite, a hard compact ore. The average material raised analyzes as follows:

Average composition of Nagpur, India, ores.

Manganese	51 to 54	Silica	5 to 9
Iron	5 to 8	Phosphorus	.05 to .12

The Vizianagram ores occur under geological conditions resembling those of Nagpur, with some variations. Being nearer to the coast it is possible to export a lower grade of ore from Vizianagram than from the central provinces.

Mr. H. G. Turner gave the composition of these ores in 1896 as follows:

Average composition of Vizianagram ores.

Manganese	45 to 50	Silica	2 to 5
Iron	7 to 13	Phosphorus	.12 to .27

In the Jabalpur district the ore is found in the Dharwar-like schist series, which forms a belt with a maximum width of 7 miles, stretching for 20 miles in a northeast-southwest direction.

The manganese ore occurring in the neighborhood of Makabaleshwar forms irregular nodules, distributed through the lateral cover on the Dekkan trap.

The production of manganese ore in India is given as follows:

Production of manganese ore in India, 1894–1904.

[Long tons.]

Year.	Madras.	Central provinces.	Central India.	Total.
1894	....	....	....	[a] 11,410
1895	....	....	....	[a] 15,816
1896	....	....	....	[a] 56,869
1897	....	....	....	[a] 73,680
1898	60,449	....	....	60,449
1899	87,126	....	....	87,126
1900	92,458	35,356	....	127,814
1901	76,463	44,428	....	120,891
1902	68,171	89,608	....	157,779
1903	63,452	101,554	6,800	171,806
1904	53,699	85,034	11,564	150,297

[a] Not subdivided, being exports, probably, from Madras presidency.

The value for export of the manganese ore produced in the year 1903 is given as £151,530 and in the year 1904 as £129,632.

Owing to the distance of the chief deposits from the seaboard, in the case of the central provinces 500 to 600 miles, and to the heavy freight charges to Europe and America, only high-grade ores can be shipped, the average ore carrying a little over 50 per cent of manganese. Most of the mines are open quarries worked with an inexpensive plant.

The latest official distribution of the exports of Indian manganese ore by fiscal years is as follows:

Exports of Indian manganese ore, by countries.

[Long tons.]

Country.	1897–98.	1898–99.	1899–1900.	1900–1901.	1901–2.	1902–3.
United Kingdom	54,279	51,931	63,175	86,269	65,150	95,540
Belgium	....	....	5,350	13,300	....	1,000
France	....	....	....	5,850	....	....
Germany	....	....	....	....	11,300	10,734
Holland	....	....	8,350	16,500	....	5,050
Egypt	....	....	....	3,400	15,000	....
United States	24,550	10,900	18,350	5,350	41,720	42,950
Total	78,829	62,831	95,225	130,669	133,170	155,274

JAPAN.

Small quantities of manganese ore are mined in Japan. In the accompanying table the first column gives the production of manganese ore from 1900 to 1902, inclusive, as taken from the Financial and Economical Annual of Japan, while the second column shows the exports of this mineral from 1900 to 1905, inclusive, together with the value from 1900 to 1905, 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 1905 are given as 831,573 kin,[a] and valued at

[a] Kin taken at 1.31 pounds.

10,584 yen ($5,267). In the earlier years practically all of the manganese ore mined was exported, but some of it is now used at the Japanese steel works.

Production and export of manganese ores, Japan, 1900–1905.

Year.	Production.	Exports.	Value of exports.	Year.	Production.	Exports.	Value of exports.
	Long tons.	*Long tons.*			*Long tons.*	*Long tons.*	
1900	15,430	12,576	$111,750	1903	....	3,258	$38,791
1901	15,858	8,726	93,214	1904	....	3,380	44,047
1902	10,592	2,625	....	1905	....	486	5,267

JAVA.

No reports of the production of manganese ores in Java later than 1899 are at hand. The quantity mined was stated to be 1,388 metric tons.

NEW ZEALAND.

The production of manganese ore in New Zealand in 1901 was 208 long tons, valued at £614 ($2,988); in 1902 no ore was mined; in 1903 the quantity won was 70 tons, valued at £210 ($1,023); and in 1904 196 long tons were obtained, valued at £570 ($2,774).

AUSTRALIA.

NEW SOUTH WALES.

Small quantities of manganese ore are intermittently obtained, the quantity mined in 1903 being 73 tons, valued at £254 ($1,234). No ore was reported mined in 1904.

SOUTH AUSTRALIA.

In 1902 there were mined 18 long tons, valued at £62 ($301), and in 1903 10 long tons, valued at £19 ($92) were produced. No production is reported for 1904.

QUEENSLAND.

In the year 1904 there were mined in Queensland 830 long tons of manganese ore, valued at £3,540 ($17,227), all of which came from the Mount Miller mine, which was described in the report for 1904. The following table gives the quantity of manganese ore produced annually in Queensland from 1900 to 1904, inclusive:

Production and value of manganese ores in Queensland, 1900–1904.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Long tons.			*Long tons.*	
1900	75	$998	1903	1,320	$25,967
1901	218	3,869	1904	830	17,227
1902	4,600	82,677			

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 used are either the long or the metric ton except in the case of Canada, where the short ton is the official unit.

World's production of manganese ores.

Country.	Year.	Quantity.	Country.	Year.	Quantity.
North America:		*Tons.*	Europe—Continued.		*Tons.*
United States	1905	4,118	Portugal	1903	30
Canada[a]	1905	22	Russia	1905	426,813
Cuba[a]	1905	6,907	Spain	1904	26,895
South America:			Sweden	1905	1,992
Brazil[a]	1905	233,950	Turkey[a]	1904	49,100
Chile[a]	1903	17,110	Norway	1904	22
Europe:			Asia:		
Austria	1905	13,788	India	1904	150,297
Bosnia and Herzegovina	1905	4,129	Japan	1902	10,592
Hungary	1904	11,527	Java	1899	1,388
France	1904	11,254	Oceania:		
Germany	1904	52,886	Queensland	1904	830
Greece	1904	7,355	New Zealand	1904	196
Italy	1904	2,836			

[a] Exports.

GOLD AND SILVER.

By Waldemar Lindgren and others.

PRODUCTION IN THE UNITED STATES.

By Waldemar Lindgren.

The production of gold and silver in the United States in 1905 is shown in the first table on the following page in approximate distribution by States and Territories. These figures are the result of conference and adjustment between the Geological Survey and the Bureau of the Mint, and are accepted as final by the two bureaus.

The output of gold and silver in the United States is ascertained by the Geological Survey by the method of "mines report," that is, by direct inquiry from the producing mines. On the other hand, the Bureau of the Mint collects its data concerning the two metals by recording the quantities and sources of bullion deposits of the United States mint and assay offices, and by statements from the smelting and refining establishments detailing the quantities and sources of the metals produced. Statistics obtained by these different methods agree strikingly in the totals for the United States, but differ more or less in detail. Some of the reasons for this are set forth more fully in the following pages. Perhaps the most important factor is that of "stock in hand" of the reduction works at the end of the year. Some of the largest discrepancies have been traced to this source, and this part of the problem will be treated more fully in the statistics for 1906.

Both methods are indispensable for a correct estimate of the actual distribution by States and districts.

The following table contains the figures accepted as final. In this table gold is calculated at $20.671834 per fine ounce and silver at 61 cents per fine ounce.

Approximate distribution, by producing States and Territories, of the product of gold and silver in the United States for the calendar year 1905.[a]

[Fine ounces.]

State or Territory.	Gold.		Silver.		Total value (silver at commercial value).
	Quantity.	Value.	Quantity.	Commercial value.	
Alabama	2,008	$41,500	300	$183	$41,683
Alaska	722,026	14,925,600	169,200	103,212	15,028,812
Arizona	130,192	2,691,300	2,605,700	1,589,477	4,280,777
California	928,660	19,197,100	1,082,000	660,020	19,857,120
Colorado	1,243,291	25,701,100	12,942,800	7,895,108	33,596,208
Georgia	4,687	96,900	900	549	97,449
Idaho	52,032	1,075,600	8,125,600	4,956,616	6,032,216

[a] Gold value: $20.671834 per fine ounce. Silver value: 61 cents per fine ounce.

Approximate distribution, by producing States and Territories, of the product of gold and silver in the United States for the calendar year 1905—Continued.

State or Territory.	Gold.		Silver.		Total value (silver at commercial value).
	Quantity.	Value.	Quantity.	Commercial value.	
Maryland	716	$14,800	100	$61	$14,861
Michigan			253,000	154,330	154,330
Missouri			12,900	7,869	7,869
Montana	236,520	4,889,300	13,454,700	8,207,367	13,096,667
Nevada	259,246	5,359,100	5,863,500	3,576,735	8,935,835
New Mexico	12,858	265,800	354,900	216,489	482,289
North Carolina	5,994	123,900	13,200	8,052	131,952
Oregon	60,222	1,244,900	88,900	54,229	1,299,129
South Carolina	4,600	95,100	100	61	95,161
South Dakota	334,460	6,913,900	179,000	109,190	7,023,090
Tennessee	160	3,300	95,500	58,255	61,555
Texas	92	1,900	417,200	254,492	256,392
Utah	248,691	5,140,900	10,319,800	6,295,078	11,435,978
Virginia	242	5,000	200	122	5,122
Washington	17,899	370,000	119,400	72,834	442,834
Wyoming	1,146	23,700	2,700	1,647	25,347
Total	4,265,742	88,180,700	56,101,600	34,221,976	122,402,676

Increase (+) or decrease (—) in production of precious metals in the United States in 1905, by States and Territories.

[Fine ounces.]

State or Territory.	Gold.		Silver.	
	Quantity.	Value.	Quantity.	Value.
Alabama	+ 591	+ $12,200	+ 100	+ $67
Alaska	+278,887	+5,765,100	— 29,500	— 12,034
Arizona	— 31,569	— 652,600	— 138,400	— 2,101
California	+ 9,787	+ 202,300	— 359,300	— 175,934
Colorado	+ 63,144	+1,305,300	—1,388,800	— 417,220
Georgia	— 1		— 600	— 321
Idaho	— 20,710	— 428,100	+ 315,400	+ 426,700
Maryland	+ 600	+ 12,400	+ 100	+ 61
Michigan			+ 125,200	+ 80,206
Missouri			+ 12,900	+ 7,869
Montana	— 10,086	— 208,500	—1,153,400	— 265,331
Nevada	+ 50,856	+1,051,300	+3,168,400	+2,013,577
New Mexico	— 5,617	— 116,100	+ 140,300	+ 92,021
North Carolina			— 1,600	— 532
Oregon	— 3,144	— 65,000	— 44,300	— 23,027
South Carolina	— 1,292	— 26,700	— 400	— 229
South Dakota	— 5,355	— 110,700	— 8,000	+ 730
Tennessee	— 48	— 1,000	+ 36,300	+ 23,919
Texas	— 18	— 400	— 52,400	— 17,876
Utah	+ 44,789	+ 925,900	—2,164,500	— 945,816
Virginia	+ 58	+ 1,200	— 6,500	— 3,764
Washington	+ 2,037	+ 42,100	— 30,500	— 14,108
Wyoming	+ 353	+ 7,300	— 1,700	— 905
Total	+373,262	+7,716,000	—1,581,200	+ 765,952

The production of gold in the United States for 1905 was 4,265,742 fine ounces, or 132,680 kilograms, equivalent to $88,180,700. This represents an increase of 373,262 ounces, or $7,716,000, over the production of 1904. The rapid advance in gold production which began in 1892, but temporarily halted from 1901 to 1903, was resumed in 1904. This increase in 1904 over the output of 1903 was approximately $7,000,000, and in all probability the increase in 1906 over 1905 will be at least the same amount. The chief sources of the great increase are as follows: Alaska added about $6,000,000 to its output of $9,160,458 in 1904, and Colorado, Nevada, and Utah added about $1,000,000 each to their product of the previous year. On the other hand, decreases are noted in Arizona, Idaho, and other States. The States producing over $1,000,000 in gold rank at present in the following order: Colorado, California, Alaska, South Dakota, Nevada, Utah, Montana, Arizona, Oregon, and Idaho.

The production of silver in the United States for 1905 was 56,101,600 fine ounces, or 1,713,852 kilograms, equivalent to $34,221,976, at an average price of 61 cents per fine ounce. In comparison with the figures of the Bureau of the Mint in 1904, this represents a decrease of 1,581,200 ounces, but in spite of this the increase in the average price of 4 cents per ounce (from 57 in 1904 to 61 in 1905) effected an addition to the value in 1904 of $765,952. Two years of better prices for silver have thus far failed to stimulate the production. The record figures were attained in 1892, when the output was 63,500,000 fine ounces, valued at $55,662,500. A still further advance to a maximum of somewhat over 70 cents has taken place in 1906, but it is not likely that the year will show startling additions to the output for 1905. The increase should be more marked in 1907, and will probably be rather derived from copper ores and dry silver ores than from lead ores.

The decrease in the quantity of silver is specially noticeable in Colorado and Utah; to a slight degree also in Montana. On the other hand, Nevada and Idaho materially increased their output. The States producing over 1,000,000 ounces rank at present as follows: Montana, Colorado, Utah, Idaho, Nevada, Arizona, and California.

A review by States brings out the more important details.

Alaska.—The great increase of $5,765,100 in gold is chiefly due to the new Fairbanks placer district on the Tanana, in the Yukon Basin, while the Nome placers and the quartz mines on the Pacific coast belt show moderate additions to their previous yield. The copper ores yielded for the first time a considerable quantity of silver with some gold. The total production of gold in Alaska is estimated at $14,925,600.

Arizona.—The moderate decline in the gold production of Arizona is due to the temporary suspension of operation on the part of some important mines in the Yavapai districts, south of Prescott. An important decrease is also noted from Yuma County. The total yield in gold is $2,691,300. The silver output also shows moderate decline. Renewed activity at the recently unwatered Tombstone mines is offset by decrease in the Yavapai districts. The total yield is estimated at 2,605,700 ounces.

California.—The continued development of the dredging industry in the State is responsible for a moderate increase in the production of gold, which now has reached $19,197,100. The great increase noted in 1904 was, however, not repeated in 1905. Less gold than in 1904 was yielded by the old productive counties of Tuolumne, Placer, Kern, and San Diego, while Amador, Trinity, Nevada, and Sierra show an increase. Nevada County, which includes the Grass Valley district, still leads with an output of over $3,000,000. Most notable are the favorable changes in the dredging counties of Butte, Yuba, and Sacramento.

A decided decline in the silver production is traceable to lessened output of siliceous ores in Kern County and of copper ores in Shasta County. Great activity prevails, however, in the copper districts at the present time, and a much larger silver production from copper ores is in view within two or three years.

Colorado.—The noteworthy addition of over $1,000,000 to the previous year's gold production in Colorado was mainly contributed by Teller (Cripple Creek), Gilpin, and Ouray counties. The production aggregated $25,701,100. The equally marked decrease in silver, by ounces, is traced to Lake (Leadville), Mineral (Creede), Clear Creek, and San Juan counties. The decrease was 1,388,500 ounces, and the total for 1905 was 12,942,800 ounces.

Idaho.—An unfavorable water season, as well as diminished activity in deep gold mining in Owyhee County, reduced the gold production of Idaho by about $500,000 to $1,075,600. On the other hand, the activity in the Coeur d'Alene lead mines in Shoshone County continued and resulted in a decided increase in the silver production of the State, although the lead ores are relatively poor in this metal. A decrease in the output of the Wood River region in Blaine County partly offset this favorable development. The total silver production was 8,125,600 ounces.

Montana.—The great copper industry of Butte continued to develop in 1905. Over $1,000,000 in gold and about 11,000,000 ounces of silver are won as by-products from the copper, but the increase in silver from this source was partly offset by the considerable decrease due to the closing of the Bimetallic Mine in Granite County. The ores of the Moccasin Mountains in Fergus County yielded by cyanide process almost the same amount in gold as the copper ores in Silver Bow County. Smaller amounts are contributed by the deep mines of Lewis and Clarke and Madison Counties. A total of $4,889,300 in gold and of 13,454,700 ounces in silver was attained.

Nevada.—The gold production of Nevada is now $5,359,100, of which total only $1,883,000 was derived from Goldfield, against $2,300,000 in 1904. The remainder comes chiefly from the De Lamar and Searchlight districts, in Lincoln County, the most southerly in the State, as well as from Tonopah, in Nye County, which is also the greatest silver-producing camp in the State. Extensive prospecting of the desert ranges of western Nevada resulted in the discovery or reopening of many camps, such as Bullfrog (Beatty, Rhyolite), Fairview, Ramsey, Wonder, Johnnie, and Manhattan, in which several prominent mines will doubtless be developed.

The silver production increased greatly and is now 5,863,500 ounces. Of this quantity by far the larger part is derived from the dry ores of Tonopah. Storey, White Pine, Eureka, and Esmeralda counties contribute the bulk of the remainder. The Comstock (Storey County) produced nearly $1,000,000 in gold and silver. A much larger output of gold and a moderate increase in silver will be recorded in 1906.

New Mexico.—Somewhat less gold was produced in 1905 than in 1904. It is hoped that development, now under way, in Sierra, Grant, and Socorro counties will again raise the value of the product to the half-million-dollar mark which the Territory had recorded in 1902.

The small silver output was increased by the operation of the mines in the Mogollon mountains.

Oregon.—The State of Oregon produced somewhat less gold and silver in 1905 than in 1904, the greatest loss in gold being recorded in Baker County, in the northeastern part of the state, and in Jackson County, in the southwestern region. The decreased output of silver was chiefly noted from Baker and Grant counties; the southwestern districts produced very little silver. Northeastern Oregon yielded about $880,000 in gold from the Blue Mountains, while the gold belt in the southwest, which includes Josephine, Lane, Jackson, Douglas, Curry, and Coos counties, and may be considered as the extension of the gold-bearing area of northern California, produced the remainder, or $364,900.

The most notable feature of recent years is the extension of the productive area northward into Lane County, among the veins contained in Tertiary lavas, as in the Blue River (Lucky Boy mine) and the Bohemia districts.

South Dakota.—Gold obtained from the ores treated by the roasting and cyanide process decreased somewhat, while the output from mines with free-milling ores remained about constant. All the mines are situated in the Black Hills, and the total yield of gold for the year was $6,913,900. The silver product was small.

Utah.—An increase of about $1,000,000 is recorded in the production of gold for 1905, which attained $5,140,900, and was mainly caused by larger shipments from Tintic and Bingham districts, as well as from the Camp Floyd district, in Tooele County.

The very notable decrease in silver of about 2,000,000 ounces was caused by the difficulties of unwatering the Park City mines in Summit and Wasatch counties. The total silver for 1905 is estimated at 10,319,800 ounces.

Washington.—An increase of $42,100 brought the gold production of Washington up to $370,000. This increase is mainly due to mines in the Pierre Lake district, Stevens County, in the northeastern corner of the State. Republic district, in Perry County, and the Mount Baker district, in Whatcom County, in the northwestern corner, furnished the bulk of the remainder. Most of the small silver production is derived from the Chewelah district, in Stevens County.

Wyoming.—The small yield of gold in Wyoming represents an increase over 1904, due to the activity of the Atlantic City district in the Wind River Mountains, Fremont County.

Southern Appalachian States.—These States, including Alabama, Georgia, Maryland, North Carolina, South Carolina, Tennessee, and Virginia, maintained an aggregate output of $380,500 in gold and of 110,300 fine ounces in silver, the most striking changes from 1904 being an increase in silver from the copper ores of Tennessee and a decrease of gold in South Carolina. Increased activity in quartz mining was noted from Alabama and Maryland. In North Carolina many mines productive in 1904 were closed, but the yield from the Iola mine, in Montgomery County, compensated for this. At present the two most important gold mines in the South are the Haile, of South Carolina, and the Iola, of North Carolina.

Michigan.—The greatly increased copper production of Michigan resulted in a greater output of silver as a by-product. The Director of the Mint estimates the silver from this source at 253,011 fine ounces.

Missouri.—The lead from the ores of southeastern Missouri contains from 1 ounce to $1\frac{3}{4}$ ounces per ton of silver. A total quantity of 12,900 ounces was recovered from this source.

MINES REPORT.

By Waldemar Lindgren.

INTRODUCTION.

For several reasons it has been deemed necessary to publish the reports from the mines in the form in which they were received by the officers of the Geological Survey. In the first place, the reports contain a wealth of important information collected at first hand concerning the production of counties and mining districts, and it was not considered advisable to force these figures by making them agree with the final estimate. It is believed further that these figures should be made public, because they represent the miner's answer to the apparently simple yet actually complicated question of the distribution of metallic products among the various States and Territories.

The replies to the inquiries sent out to the producers have continued to meet with a gratifying response, and estimates have been necessary only in comparatively few cases. With the exception of Alaska, over 98 per cent of the production of gold and silver tabulated below is based on direct returns, and less than 2 per cent is estimated. The estimates include two large mines, one in California and one in Colorado, which have refused replies; a number of small mines from which, for various reasons, no replies could be obtained; and, further, the production of transient placer miners in the South, in New Mexico, and in California. There are other items, however, which may easily escape the collector of statistics by this method and which may result, for instance, from retreatment of slags or of old metallurgical by-products. The gold from stolen ore in rich camps, such as Cripple Creek, Goldfield, and Grass Valley, which is believed by many to make a considerable sum in the aggregate, is collected by small assay offices and naturally is not represented in these tables of individual returns.

Further errors may arise through mistakes in the replies, a common one being the returning of the net smelter returns instead of the gross amount. Willful misstatements have been traced in the returns from a few small mines, but are very rare.

When the metals are obtained as placer gold or from the mills at the mines little difficulty is encountered. The case is somewhat different with regard to custom-smelting ores, where the miner has no way of measuring the bullion actually extracted except by the assay. The loss of gold in lead smelting is extremely small, and the figures used are the ounces calculated from the assay; but in the case of silver the loss is commonly estimated at 5 per cent by the smelters, which rate probably leaves them a safe margin. It has been noted that most frequently when ounces are given in the replies the amounts corresponds to 95 per cent of the assay value, and thus the returns should correspond closely with the direct smelter returns for silver obtained by the Bureau of the Mint.

Ordinarily gold is not paid for in ores when below five one-hundredths part of an ounce, but this in the aggregate amounts to a fairly large sum. As examples may be cited some of the Leadville lead ores, for which a separate estimate had to be given, and also some of the lead concentrates from northern Idaho. The small amount of gold in electrolytically refined copper is usually correctly obtained from the producing mining companies.

Silver is not as a rule paid for unless it runs above 2 ounces per ton, but as the ores treated in custom smelters rarely contain less than this quantity, there is very little from this source which escapes this method of collecting statistics. As an example may be cited the small quantity of silver in the Cripple Creek smelting ores, for which a separate estimate had to be made. The low silver values contained in certain copper ores are, like the gold, recovered by the electrolytic method and are directly reported by the mining companies.

Summing up the comparative merits of the "mines report" method and the "smelter and refinery" method, one notes that the first is dependent upon a complete mine list and upon accurate returns from the mines, while the latter is dependent upon the accuracy of the data from the smelters. The smelter records are, however, not kept for the purpose of compiling statistics for the whole country, so that in reference to special districts wholly technical and, from point of view of the reduction works, unavoidable errors may easily be introduced. Moreover, there is the very important matter of the "stock on hand," which is almost sure to make the smelter returns differ from the mines report. The miner in his answer includes all smelter and mint returns which have been received up to the last day of December, while the smelter reports only the bullion which has been turned out up to that date. In individual cases important differences between State and county reports received by these two methods have been actually traced to this factor. Special efforts will be made in future reports by the Geological Survey, in cooperation with the Bureau of the Mint, to account strictly for the discrepancies which may be found.

In the West, gold and silver are so intimately connected with copper, lead, and zinc that it was found desirable to include the latter in the queries addressed to the mines. Here increased difficulties are met, especially in States with extensive custom smelting, like Colorado. Greater losses must be counted on in smelting these metals than in the case of gold and silver. Lead is only paid for in the ores when it runs over 5 per cent., except in special cases of large contracts. Consequently a certain quantity, sometimes a large quantity, is reported from smelter returns, for which no mine returns can be obtained. According to local conditions such discrepancies are more or less easily traceable. Copper, again, is only paid for when it runs over 1½ per cent wet assay, and 1½ per cent or more is usually deducted from any wet assay. Here, again, the answers most commonly record the pounds of copper for which pay was obtained. Colorado, for instance, does not have a large production of copper, and yet it has been found that the smelter returns, as recorded by the State authorities, the mint, and the Geological Survey, greatly exceed the mines report. From the mines the most careful canvass resulted in returns of about 6,000,000 pounds, while the actual output of copper from Colorado ores was undobutedly over 9,000,000 pounds.

The mines report of copper and lead are thus apt to be somewhat lower than the smelter reports in States with much custom smelting, but experience has shown that serious errors may occur also where the latter are exclusively relied on. The best results will be obtained from a combination of the two methods, such as will be inaugurated by the Geological Survey for the year 1906.

The recently developed zinc industry of the West has proved difficult of exact measurement. The ores vary so widely in character and tenor that the Missouri Valley measure by tons of ore is practically useless. The loss of metal in smelting is much greater than in case of lead and copper, so that the spelter actually recovered from a given ore is difficult to estimate. In this report the loss has been assumed to be 25 per cent, and the mines have been requested to give assay value and tonnage from which the probable spelter has been calculated. A better way probably is to count 8 per cent off on all percentages. Few ores below 25 per cent are utilized; the majority of ores average about 35 per cent, while concentrates and exceptionally rich ores range from this figure up toward 60 per cent. Sulphide ores prevail. New Mexico still ships large quantities of oxidized ores, but these will soon be exhausted and sulphides will take their place. A part of the zinc ores are shipped to the Mississippi Valley smelters, the only reduction plant in the West being that of the United States Zinc Company at Pueblo, Colo. The United States Smelting Company at Pueblo makes zinc-lead pigment from the zinc-lead ores of Aspen and other places.

In marketing zinc ores for spelter, cobalt, nickel, antimony, and fluorine are very objectionable constituents. Lead in such ores is usually not paid for, and a large percentage is not desired. Lime above 4 per cent and iron above 6 per cent are often penalized. It is difficult to give average prices paid, as the schedules vary and are rather complicated. A 40 per cent zinc ore otherwise satisfactory would probably be paid for at the rate of $20 per ton, less freight to smelter. There is seldom much gold in zinc ores, but silver is nearly always present. A small payment is usually received for silver above 5 ounces per ton. The cinders from the zinc retorts in the Mississippi Valley seldom contain enough silver to warrant treatment, but the Pueblo plant transfers its cinders from Colorado ores to the American Smelting and Refining Company, which extracts a considerable quantity of silver and a little gold from them.

It is often difficult to ascertain whether, in a given zinc ore with low tenor of silver, the latter metal has actually been recovered or not.

UNITS OF MEASUREMENT.

Gold and silver are measured by the fine ounce. In the mines report of the United States Geological Survey gold is calculated at $20.671834 per fine ounce, and the average commercial price of silver at New York for 1905 is taken as 60.4 cents per fine ounce. The average price of crude platinum is $17 per ounce. As to the base metals, the average price of copper in 1905 is taken as 15.6 cents per pound, that of lead as 4.7 cents per pound, and that of zinc as 5.9 cents per pound. These are the

New York prices, and it should be distinctly stated that the miners do not by any means obtain these prices from the custom smelters. Hence, the columns giving the amounts in dollars are in a way misleading; but it has been thought best to give the tables this form, for to most persons a relatively more distinct conception is conveyed by statements in terms of dollars than in terms of pounds.

The standard unit for ore production is the short ton of 2,000 pounds.

PRODUCTION OF GOLD AND SILVER REPORTED FROM THE MINES.

The following table gives the quantity and value of gold and silver reported by the producing mines to the officers of the United States Geological Survey.

The last column in the table gives the increase or decrease in value as compared with the mines report of the preceding year as recorded in Mineral Resources for 1904.

Production of gold and silver[a] in the United States in 1905, as reported from the mines to the United States Geological Survey, by States and Territories.

[Fine ounces.]

State and Territory.	Gold.		Silver.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Gold.	Silver.
Alabama	2,009	$41,530	336	$203	+ $12,230	+ $87
Alaska	756,101.28	15,630,000	132,724	80,165	+6,469,542	− 30,240
Arizona	135,412	2,799,214	2,605,712	1,573,850	− 679,318	+ 248,547
California	914,217.14	18,898,545	1,076,174	650,009	+ 264,869	− 193,927
Colorado	1,210,534.73	25,023,973	11,499,307	6,945,581	+ 560,651	−1,039,447
Georgia	4,688	96,910	1,040	628	+ 10	− 242
Idaho	52,033	1,075,618	8,679,093	5,242,172	− 634,747	+ 853,168
Maryland	717	14,821	93	56	+ 12,421	+ 56
Michigan	....	....	253,011	152,819	....	+ 82,819
Montana	231,913.75	4,794,083	13,231,300	7,991,705	+ 527,021	+ 657,559
Nevada	254,927.51	5,269,819	6,482,081	3,915,177	+ 209,325	+1,482,347
New Mexico	15,359.56	317,510	369,192	222,992	− 64,420	+ 98,889
North Carolina	6,080	125,685	20,230	12,219	+ 1,785	+ 3,635
Oregon	67,978.23	1,405,235	90,636	54,744	− 6,951	− 20,540
South Carolina	4,601	95,111	111	67	− 26,689	− 223
South Dakota	338,116.70	6,989,492	182,749	110,381	− 374,485	+ 17,859
Tennessee	211	4,362	95,522	57,695	+ 62	+ 23,359
Texas	12	248	387,506	234,054	+ 62	+ 20,119
Utah	248,692	5,140,920	11,036,471	6,666,028	+ 951,628	− 232,280
Virginia	241	4,982	177	107	+ 1,182	− 3,779
Washington	19,595.63	405,078	125,376	75,727	+ 90,615	− 14,104
Wyoming	1,293.81	26,745	3,655	2,208	+ 9,440	− 453
Total	4,264,734.34	88,159,881	56,272,496	33,988,587	+7,324,233	+1,953,209

[a] In the following tables of this report the basis of calculation of values for the various metals in 1905 is as follows: Gold, $20.671834 per fine ounce; silver, 60.4 cents per fine ounce; copper, 15.6 cents per pound; lead, 4.7 cents per pound; zinc, 5.9 cents per pound; platinum, $17 per crude ounce.

ORE PRODUCTION, NUMBER OF MINES, AND AVERAGE VALUES.

The wonderful development of the mining industry in 1905 is clearly indicated in the tonnage handled by the mines. The following table shows the number of mines, the ore production, and the average values. To illustrate fully the advance in the various branches, the tonnage should be further subdivided into classes of ore.

Number of producing mines, ore production, and average value of gold and silver per ton in 1905, by States.

State and Territory.	Number of mines.			Ore production from deep mines.	Average value of gold and silver per ton of ore from deep mines.
	Placer.	Deep.	Total.		
				Short tons.	
Alabama	1	2	3	16,525	$2.46
Alaska	a1,100	18	a1,118	1,422,515	2.46
Arizona	12	122	134	2,678,059	1.62
California	658	481	1,139	2,696,603	5.06
Colorado	23	490	513	2,504,087	12.73
Georgia	a12	a10	a22	a16,000	a4.18
Idaho	152	105	257	1,669,038	3.58
Maryland	......	2	2	2,698	5.51
Montana	78	254	332	5,020,137	2.47
Nevada	10	122	132	432,202	21.25
New Mexico	21	52	73	145,629	3.03
North Carolina	7	16	23	18,831	6.76
Oregon	167	66	233	150,268	8.03
South Carolina	......	2	2	49,493	1.92
South Dakota	12	20	32	1,837,411	3.86
Tennessee	1	2	3	399,330	.15
Texas	......	6	6	22,345	10.49
Utah	7	114	121	2,181,061	5.41
Virginia	a3	a4	a7	a800	a5.35
Washington	16	35	51	46,650	10.17
Wyoming	7	6	13	31,007	.87
Total	2,287	1,929	4,216	21,340,689	4.82

a Estimated.

A comparison with the corresponding table in the report for 1904 shows that the number of mines producing gold and silver has decreased somewhat. Of placer mines, exclusive of Alaska and the Southern Appalachian States, 1,334 were reported in 1904 and 1,163 in 1905. Of deep mines, exclusive of the same regions, 1,905 were reported in 1904 against 1,873 in 1905. This represents a total decrease of 203. The total, in part estimated, number of mines in the United States in 1905 is 4,216.

In the matter of tonnage different results are shown. In 1904 the total tonnage from deep gold and silver mines, exclusive of the Southern Appalachian States, was 19,229,746 short tons, but the above table shows that, with the same exception, the quantity in 1905 was 20,837,012 short tons, or an increase of 1,607,266 tons. This great addition to the tonnage of 1904 is distributed among nearly all of the States. Decreases are shown in Oregon, Washington, and Wyoming, and a slight decrease is noted in California also, partly due to a lessened copper output in Shasta County. The increase in Idaho and South Dakota is very small. In Utah the ore production increased by 464,000 tons, due to the great development of the copper mining industry, chiefly in the Bingham camp. In Montana the Butte copper mines were responsible for 377,000 additional tons. In Arizona the Bisbee copper camp and other developments caused an addition of 374,000 tons of ore. In Colorado, Cripple Creek and Gilpin County added to their tonnage of 1904. The total increase in Colorado was 170,000 tons. The States mining over 1,000,000 tons of ore rank as follows: Montana, California, Arizona, Colorado, Utah, South Dakota, Idaho, Alaska.

The average values in gold and silver per ton are, as a rule, somewhat lower than in 1904, indicating that the greater quantity of ore produced has permitted the mining of a somewhat lower grade of ore. Nevada still stands alone, with an average value of $21.25. Colorado follows with an average of $12.73, which is only maintained at this high point by reason of the high-grade Cripple Creek ores. Wherever copper ores enter to large extent into the tonnage, as in Arizona, Montana, Utah, and Tennessee, the average value per ton is greatly depressed. California's gold quartz ores average only slightly higher than the figures given for the whole State, $5.06, while those of Alaska have only half of this average value. The free-milling and cyaniding gold ores of South Dakota averaged $3.86.

One of the most striking facts in the mining industry of the last few years is the gradual development of the leasing system, by which a mine or a part of a mine is worked by lessees upon the payment of a royalty or a certain percentage per ton.

CLASSIFICATION OF ORES.

The gold and silver product is divided according to its derivation from placers, from dry or siliceous ores, copper ores, lead ores, zinc ores, copper-lead or copper-lead-zinc ores, and lead-zinc ores.

These divisions of the ores from the deep mines are, of course, to a certain degree arbitrary, and in many cases of complex ores doubt exists about their proper classification.

In general, ores which contain 2½ per cent or more of copper are considered as copper ores, while those with over 4½ per cent of lead are called lead ores. Special divisions of mixed ores, such as copper-lead and lead-zinc, have been established. The bulk of the zinc ores contain at least 25 per cent of that metal. The classification is based on the quality of the ore *as mined.*

DISTRIBUTION OF THE GOLD PRODUCT OF 1905.

The following table shows the source of gold in the United States in 1905, by kinds of ore and by States:

Source of gold in 1905 in States and Territories, as reported from the mines to the United States Geological Survey, by kinds of ore and by States.

[Fine ounces.]

State.	Placers.	Dry or siliceous ores.	Copper ores.	Lead ores.	Zinc ores.	Copper-lead or copper-lead-zinc ores.	Lead-zinc ores.	Total.
Alabama	50	1,959						2,009
Alaska	586,499.53	166,168.13	3,433.62					756,101.28
Arizona	2,064	67,572	55,668	9,270		121	717	135,412
California	285,029.17	617,856.11	10,867.46	464.40				914,217.14
Colorado	4,855.71	1,165,232.96	3,884.13	31,667.99	1,846.39		3,047.55	1,210,534.73
Georgia	1,451	3,159	78					4,688
Idaho	16,470	34,282	833	362		10	76	52,033
Maryland		717						717
Montana	19,200.07	154,792.94	52,881.44	4,899.10		140.20		231,913.75
Nevada	400.25	253,015.54	51.33	1,460.39				254,927.51
New Mexico	4,805.34	10,371.92	44.43	137.87				15,359.56
North Carolina	484	5,224.50	372					6,080
Oregon	12,172.06	54,970.23	835.94					67,978.23
South Carolina		4,601						4,601
South Dakota	443.27	337,673.43						338,116.70

Source of gold in 1905 in States and Territories, as reported from the mines to the United States Geological Survey, by kinds of ore and by States—Continued.

State.	Placers.	Dry or siliceous ores.	Copper ores.	Lead ores.	Zinc ores.	Copper-lead or copper-lead-zinc ores.	Lead-zinc ores.	Total.
Tennessee	10		201					211
Texas		12						12
Utah	322	64,383	125,897	17,805	95	38,500	1,690	248,692
Virginia	39	202						241
Washington	311.48	18,993.99	290.16					19,595.63
Wyoming	102.38	961.11	230.32					1,293.81
Total	934,709.26	2,962,147.36	255,567.83	66,066.75	1,941.39	38,771.20	5,530.55	4,264,734.34

Placers.—Placer gold was obtained in 1905 to the amount of 934,709.26 fine ounces, equivalent to $19,222,155, while in 1904 the quantity was only 612,631 ounces, valued at $12,664,206. This striking increase is almost exclusively due to Alaska and California. In the other States the placers, as a rule, decreased their yield, and this applies especially to Idaho, New Mexico, and Colorado. A dry season was responsible for part of the loss in Idaho. The increase in Arizona is more technical than real, as the production from dry washing on a small scale had been underestimated in previous years.

Unless wholly unexpected sources of placer gold are found, it is likely that the placer returns from the central States of the West will gradually diminish. The dredge has only found a congenial place in a few regions of these States. In the mountainous country the bowlders interfere with successful work; and in valleys the gold, as a rule, is too fine and too scattered. At present there are 5 dredges working in Montana, 1 in Colorado, 3 in Idaho, and 1 or 2 in Oregon, a total of not more than 11. Contrasted with this the conditions in California at the foot of the Sierra Nevada are extremely favorable for the deposition of the moderately fine gold carried down by the rapid currents of the canyon streams.

California reports 285,029.17 fine ounces from placers. In the report for 1904 the placer yield of California was 241,185 fine ounces, the increase in 1905 being nearly 44,000 ounces, all of which is due to the increase in dredging work in Butte (Oroville), Yuba, and Sacramento counties. Depths of 50 or 60 feet are now attained with the largest and most powerful machines. The actual yields of dredging operations in California are as follows: 1904, $2,187,038; 1905, $3,276,143; increase, $1,089,105. The yield from hydraulic, drift, and surface mining decreased in 1905. Twenty-six dredging companies are operating in California, and many of them have several dredge boats. The increase in the placer yield of Alaska is far greater. In 1904 the production was 290,276 ounces, but in 1905 it had increased to 586,500 ounces, equivalent to $12,124,030. As is well known, the increase came chiefly from the new diggings on the lower Tanana, but it is encouraging to note that the Seward Peninsula also added to its output by reason of large operations. Two dredges are in operation on the Seward Peninsula, and it is believed that, although the season is short, the nonfrozen ground along the creeks and rivers in Alaska offers excellent prospects at many places for the successful operation of the dredge.

Dry and siliceous ores.—The gold won from siliceous and dry ores increased but slightly over the amount recorded for 1904, and remains a trifle below 3,000,000 ounces, or somewhat less than three-fourths of the total output of 4,264,734 ounces.

The States which yielded over 100,000 ounces from this source rank as follows: Colorado, California, South Dakota, Nevada, Alaska, and Montana. None of the increases or decreases are very striking.

This division necessarily includes a great variety of ores, which, briefly enumerated, are as follows: The quartzose free-milling gold ores include those of southeastern Alaska, and especially of Douglas Island, where now 880 stamps are dropping; those of the Oregon and the California gold belts; those of the central Arizona and the Yavapai gold regions; those of the Telluride and Ouray belt in Colorado; those of scattered Montana and Idaho mines, and those of the great Homestake mines in the Black Hills of South Dakota, where 1,000 stamps are dropping.

The quartzose gold-silver ores, which ordinarily are only imperfectly amenable to direct amalgamation, include the rich ores of western Nevada, most of which are now smelted, but which can be treated also by a combined amalgamation concentration and cyanide process. Scattered ores from Arizona, from Colorado, from Silver City in Idaho, and from other sources contribute also to this total.

The quartzose gold ores formed by replacement of limestone add a fairly large amount of gold. The metal occurs in these ores in fine distribution, sometimes, indeed, as a telluride, and the cyanide process is used for its recovery. The three most prominent localities are the Camp Floyd (Mercur) district in Utah, the Black Hills of South Dakota, and the Moccasin Mountains of Fergus County, Mont.

The dry or siliceous ores further include the quartzose ores of Cripple Creek, Colo., in which the prominent characteristic is the occurrence of large quantities of gold tellurides. These ores are partly smelted, partly chlorinated, and partly cyanided, all three processes being applicable.

There is, finally, a large class of dry ores which contain pyrite and other sulphides and which are best treated by the smelting process, with or without concentration. Colorado contributes by far the largest quantity of these ores, among which those of Leadville are of particular importance.

Copper ores.—A total of 255,568 ounces of gold were obtained from copper ores in 1905, against 237,116 ounces in 1904. The increase is wholly due to the development of the great copper mines from which gold is obtained as a by-product in the refining of the copper. The richest of these ores are obtained from Utah (Bingham, San Francisco, and Tintic districts), in which State the gold from this source increased from 109,968 ounces in 1904 to 125,897 in 1905.

The Butte, Mont., copper ores are poorer in gold, but the increase in copper production was here, too, felt in the yield of gold. The same applies to Arizona, the copper ores of which are, as a rule, very poor in gold and silver. In California alone the yield of gold from copper ores decreased from 24,727 ounces in 1904 to 10,867 ounces in 1905, owing to a temporary lull in the Shasta County industry. Idaho records an increased but still small output from the Seven Devils and from the Cœur d'Alene, and the same is to be said of Oregon, where the Takilma mine was the principal producer. The quantity of gold obtained from Colorado copper ores remained about stationary. Nearly all of the copper ores are classed as sulphides.

Lead ores.—From lead ores proper only 66,067 ounces of gold were obtained, chiefly from Colorado, Utah, Arizona, Montana, and Nevada. The lead ores have been further subdivided this year into lead ores proper and copper-lead ores, but even the combined output of the two fails to come up to the figures for 1904. The decrease is about 18,000 ounces and is most strongly pronounced in Colorado. The decrease in this State is, however, partly compensated by increases from the Tintic district in Utah and from the Tombstone district in Arizona. Rich lead ores are growing notably scarce. The copper-lead ores containing gold are, on the whole, rare and are principally represented in the Tintic district.

Zinc ores.—Although there is ordinarily but little gold in zinc ores and lead-zinc ores, a total of about 7,500 ounces is credited to this source, an increase of 2,800 ounces over the figures for 1904. Most of this gold is associated with a predominant amount of silver and is derived from Leadville and many other localities in Colorado.

Of the other States, Utah yielded 1,785 ounces from lead-zinc ores and Arizona 717 ounces. Neither of these States were represented in these columns in 1904.

Practically no gold is derived from oxidized lead and zinc ores, of which only a small quantity is now marketed.

DISTRIBUTION OF SILVER PRODUCT IN 1905.

The following table shows the source of silver in the United States in 1905, by kinds of ore and by States:

Source of silver in 1905 in States and Territories, as reported from the mines to the United States Geological Survey, by kinds of ore and by States.

[Fine ounces.]

	Placers.	Dry or siliceous ores.	Copper ores.	Lead ores.	Zinc ore.	Copper-lead or copper-lead-zinc ores.	Lead-zinc ores.	Total.
Alabama	5	331						336
Alaska	75,092	31,107	26,525					132,724
Arizona	306	441,952	1,480,732	594,330		88,392		2,605,712
California	27,367	607,161	388,169	53,477				1,076,174
Colorado	908	6,107,559	55,388	3,883,827	916,391		535,234	11,499,307
Georgia	100	271	669					1,040
Idaho	3,482	861,637	486,450	7,277,408		30,653	19,463	8,679,093
Maryland		93						93
Michigan			253,011					253,011
Montana	2,573	1,797,722	10,624,594	798,855		7,556		13,231,300
Nevada	98	6,183,588	1,689	291,953	4,753			6,482,081
New Mexico	662	295,484	19,962	53,084				369,192
North Carolina	100	3,000	17,130					20,230
Oregon	1,945	85,177	1,825	1,689				90,636
South Carolina		111						111
South Dakota	52	182,697						182,749
Tennessee	1		95,521					95,522
Texas		387,506						387,506
Utah	61	94,497	2,301,349	3,104,375	18,108	5,290,122	227,959	11,036,471
Virginia	4	173						177
Washington	60	107,737	6,374	11,205				125,376
Wyoming	10	86	3,559					3,655
Total	112,826	17,187,889	15,762,947	16,070,203	939,252	5,416,723	782,656	56,272,496

Placers.—In 1905 there were 112,826 ounces of silver obtained from placers. This is apparently a large increase over 1904, but to some degree only apparently so, for up to the present time the silver from this source has been largely overlooked.

Dry and siliceous ores.—The total quantity from this source was 17,187,889 ounces, compared with 16,315,608 in 1904. This is a trifle less than one-third of the total silver production, which this year is divided fairly well between dry ores, copper ores, and lead ores, the latter, however, still predominating. The States rank in production as follows: Nevada, Colorado, and Montana, which States produced each over 1,000,000 ounces. The States which produced over 100,000 ounces each rank as follows: Idaho, California, Arizona, Texas, New Mexico, South Dakota, and Washington. Utah yielded only 94,497 ounces. Nevada and Colorado produced each somewhat over 6,000,000 ounces. Nevada contributes the quartzose gold-silver ores of Nye and Storey counties, equivalent to the Comstock and Tonopah ores; almost the whole quantity came from these districts. Colorado, on the other hand, has some of this class of ores, chiefly in San Miguel County (Telluride district), but most of the silver is derived from dry ores containing lead and zinc in Leadville and Creede, equivalent to Lake and Mineral County ores. These ores are, as a rule, concentrated and smelted.

Copper ores.—Silver to the amount of 15,762,947 fine ounces was obtained from copper ores in 1905. This is a decrease of 5,360 ounces compared with the figures for 1904, a somewhat surprising result in view of the considerable expansion of the copper mining industry in the Western States. By far the greatest quantity is derived from copper ores carrying only a few ounces of silver, and the metal is really won as a by-product in the electrolytic refineries. A little over two-thirds of the whole quantity—to be exact, 10,624,594 ounces—is obtained from Butte, Mont., which State also shows an increase of about 400,000 ounces over last year's figures for copper ores. Utah is next in rank, with 2,301,349 ounces, a decrease of 271,233 ounces from 1904. This decrease is really technical rather than actual, for some of the ores classed as copper ores in 1904 have this year been tabulated as copper-lead ores.

Arizona is third in rank, with 1,480,732 ounces against 1,464,731 in 1904. The principal source of argentiferous copper ores is the United Verde mine at Jerome. At Bisbee a largely increased tonnage of copper ores was mined, but they are extremely poor in silver.

Other States which yielded over 100,000 ounces of silver from copper ores are as follows: Idaho, California, and Michigan. California shows a notable decrease, and Idaho took its place. Colorado produced only 55,388 ounces from ores which could be classed as copper ores.

Almost all of the silver-bearing copper ores of the West are now sulphides. Small quantities of oxidized ores are still contributed by Arizona and New Mexico.

Lead ores.—Like the gold, the silver from this source has been subdivided, according to derivation, from lead ores proper or from lead-copper ores. The total is about 21,500,000 ounces, which is a slight decrease from the figures of 1904. In production of silver from lead ores Idaho leads with over 7,000,000 ounces, an increase of nearly 700,000 ounces over 1904. The Coeur d'Alene mines in Shoshone County increased their yield very considerably, while the Wood River districts in Blaine County show a decrease. Colorado follows Idaho with a production of 3,883,827 ounces, representing a decrease of over 500,000 ounces compared with 1904. Pitkin (Aspen district), Lake (Leadville), San Juan, and Clear Creek counties contain the principal contributing camps. Utah ranks third and adds 3,104,375 ounces to the silver production from lead ores. A comparison with the output of 1904 shows that the production of silver from the combined lead and lead-copper ores was about 900,000 ounces less in 1905 than in 1904. The decreased output from the mines of Summit and Wasatch counties (Park City district) was thus not fully compensated by the increase from the Bingham, Tintic, and Frisco camps.

Montana ranks fourth among the States producing silver from lead ores, and is followed by Arizona and Nevada, but none of the three yields a million ounces from this source.

Only a very small amount of silver is derived from oxidized lead ores, which are beginning to get very scarce, and which, moreover, ordinarily contain but little silver.

Copper-lead ores.—Copper-lead ores are marketed from Arizona, Idaho, and Montana. The similar ores from Colorado contain, as a rule, too little copper to be properly classed as copper-lead ores. In Utah copper-lead ores are especially abundant, and a large quantity of silver, 5,290,122 ounces, was derived in 1905 from the Park City, Tintic, Bingham, and San Francisco districts, ranking in the order named. At Tintic, as well as at Bingham, the larger part of the silver was derived from copper-lead ores rather than from straight copper or lead ores.

Zinc ores and zinc-lead ores.—In 1904 Colorado was the only State from which silver from zinc ores was reported, but the quantity was almost 2,000,000 ounces. In 1905 the total quantity was a little less, or about 1,700,000 ounces; but Utah, Arizona, Idaho, Montana, and Nevada began shipping zinc ores. By far the greatest quantity of silver from this source was, however, contributed by Colorado, whose production decreased to about 1,500,000 ounces.

Practically all of these ores are sulphides. Only New Mexico shipped oxidized ores, but the small quantity of silver which they contained is, according to reports, not recovered. In all, the zinc ores proper yielded 959,252 ounces, and the lead-zinc ores 782,656 ounces.

GOLD AND SILVER IN 1905 BY STATES AND TERRITORIES.

ALASKA.

By Alfred H. Brooks.

INTRODUCTION.

In 1905 plans were formulated for collecting annually the statistics of the precious metal production in the various mining districts of Alaska. The remoteness of many of the mining districts of the Territory and the ephemeral character of a part of the mining population in the placer fields make it exceedingly difficult to obtain even an approximately correct list of the mine operators, a difficulty increased by the reluctance that placer miners often show toward revealing any information regarding their gold production. It is gratifying, however, to be able to report that many residents of the Territory, quick to realize the importance of the undertaking, have aided it by every means in their power.

In those districts where the statistics obtained by schedule were incomplete the writer has relied on general estimates, based on the best data available. These estimates are in part figures furnished by the field parties of the Geological Survey, in part those obtained from residents of the Territory.[a] Therefore, while the precious metal production, as given in the following tables, can not be regarded as absolutely accurate, it is believed to be near enough to the truth to have value to the mining interests. The limit of error in the statistics of gold production is believep to be less than $100,000. In any event, the tables present the first attempt at a distribution of the output according to districts. A preliminary statement of the distribution of the gold output has already been published.[b]

Alaska not being divided into counties, the production is referred to the natural geographic subdivisions in common usage, such as southeastern Alaska, Copper River basin, Cook Inlet region, Yukon basin, and Seward peninsula. Where estimates are available, the production of the individual mining districts [c] as defined by local usage is given. In the general tables southeastern Alaska and Prince William Sound are combined under the name Pacific Coastal Belt.

The gold production of Alaska in 1905 is estimated at $15,630,000, and the silver at $80,165; the number of ounces of gold was 756,101.28 and of silver 132,724. In 1904, according to the Director of the Mint, the output of gold was valued at $9,160,458. This increase in gold output of 312,924 ounces, valued at $6,469,542, must be credited in large measure to the placer mines of the Fairbanks region; but practically all the other districts showed some increase in production. The copper output of Alaska for 1905 is estimated at 4,805,238 pounds, valued at $749,617. The distribution of the mineral production is as follows:

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[a] These estimates were furnished by Messrs. F. L. Hess, F. H. Moffit, L. M. Prindle, Sydney Paige, and C. W. Wright of the United States Geological Survey, and by Messrs. C. D. Garfield, H. H. Hildreth, G. W. Easterly, Frank E. Howard, Alfred S. Kepner, L. L. James, H. F. Thumm, A. J. Childs, C. L. Lewis, W. B. Stewart, and M. F. Moran, residents of Alaska.

[b] Bull. U. S. Geol. Survey No. 259, 1905.

[c] The term "mining district" has no legal significance. The administrative unit of Alaska is the recording precinct; but its boundaries are often subject to such frequent changes that it has little value for statistical purposes.

Production of gold, silver, and copper in Alaska in 1905, by districts.

District.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*		*Pounds.*	
Pacific coast belt, including southeastern Alaska and Prince William Sound	165,926.26	$3,430,000	57,791	$34,908	4,805,238	$749,617
Copper River and Cook Inlet	24,187.48	500,000	2,660	1,606	....	....
Yukon basin	333,787.54	6,900,000	46,732	28,224	....	....
Seward Peninsula	232,200.00	4,800,000	25,541	15,427	....	....
Total	756,101.28	15,630,000	132,724	80,165	....	....

The increase of 75 per cent in the gold output of 1905 as compared with 1904 is an index of the development of the mining industry as a whole. Though this additional gold was for the most part taken from a few rich creeks in the Fairbanks district, yet it is not to be interpreted as simply a temporary inflation of the gold production, for it will be many years before Alaska's placers reach their maximum productiveness. It is known now that the output of the placers for 1906 will exceed by several million dollars the production of 1905. The development of the auriferous lode mines is relatively slow, but the copper mines have shown a very marked advance in production in comparison with that of 1904. The figures of the total production of gold, silver, and copper in the years 1904 and 1905 are shown in the following table:

Production of gold, silver, and copper in Alaska in 1904 and 1905.

	1904.		1905.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold............fine ounces..	[a]443,177	$9,160,458	756,101	$15,630,000	+ 312,924	+$6,469,542
Silver..................do....	([b])	....	132,724	80,165	....	....
Copper.............pounds..	2,043,586	[c]269,957	4,805,238	749,617	+2,761,652	+ 479,660

[a] The production of ounces of gold for 1904 (Mineral Resources of the United States, 1904, p. 143) is based on a valuation of $20.67 per fine ounce, while that of 1905 is based on the valuation of $20.671834 per fine ounce.

[b] The statistics for the production of silver in 1904 are considered unreliable and are therefore not included in this table.

[c] Based on a valuation of 13.5 cents per pound.

It is unfortunate that the statistics for the silver output of 1904 are so unreliable that a comparison with 1904 is not possible. It seems probable, however, that the production of silver in 1905 was greater than that of 1904.

In the following table the gold production of 1904 and 1905 is shown by districts. As the distribution of the gold output of 1904 was made on very incomplete data, this part of the table can only be regarded as an approximation to the truth.

Value of gold production of Alaska in 1904 and 1905, by districts.

District.	1904.	1905.	Increase.
Pacific coast belt, including southeastern Alaska and Prince William Sound	$3,195,858	$3,430,000	$234,142
Copper River and Cook Inlet regions	500,000	500,000	....
Yukon basin	1,300,000	6,900,000	5,600,000
Seward Peninsula	4,164,600	4,800,000	635,400
Total	9,160,458	15,630,000	6,469,542

With regard to the sources of the metals according to character of deposits the gold placers are by far the largest producers, more than three-fifths of the entire output being credited to this source; the siliceous lode mines are next in value of product, and the copper lode mines last. The value of the auriferous lode mine production was $3,050,977 in 1904 and $3,435,000 in 1905, an increase of $384,023. Statistics of the production of silver of the lode mines in 1904 are lacking, and comparisons can not be instituted. In the following table the source of the precious metals is indicated:

Source of gold, silver, and copper in Alaska in 1905, by kinds of ore.

Ores.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*		*Pounds.*	
Siliceous ores	166,168.13	$3,435,000	31,107	$18,789	....	....
Copper ores	3,433.62	71,000	26,525	16,021	4,805,238	$749,617
Placers	586,499.53	12,124,000	75,092	45,355	....	....
Total	756,101.28	15,630,000	132,724	80,165	4,805,238	749,617

Returns from the statistics show that 10 gold and silver mines were on a productive basis in 1905, probably about the same number as in 1904. Upward of a score of auriferous lodes were being systematically prospected or developed. It has been impossible to collect reliable information as to the number of placer mines in operation in 1905. It is believed that, counting operators who work but a single claim, between 1,000 and 1,200 different mines were more or less productive in 1905.

Of copper mines 5 were on a productive basis in 1904 and 8 in 1905, while many more were being opened up.

The tonnage of all the lode mines of Alaska in 1905 was 1,422,515 short tons, an increase of probably about 40,000 tons over 1904. Of siliceous ores 1,370,316 tons were mined, of which 1,296,271 tons must be credited to the three mines of the Treadwell group on Douglas Island, near Juneau, leaving only 74,045 tons as the product of the other gold-quartz mines. The average gold and silver value of all siliceous ores was $2.63 per ton. For the 74,045 tons of siliceous ores other than those from the Treadwell group it was $5.60. A total of 52,199 tons of copper ores contained an average of $1.66 per ton of gold and silver, and copper to the amount of 4.61 per cent. It should be stated that the values of the siliceous ores mined thus far lie almost altogether in the gold, the silver values being often less than 1 per cent of the total. The high percentage of copper is accounted for by the fact that the Prince William Sound mines, which contributed a large percentage of the total tonnage in 1905, have so far shipped only high-grade ores. The copper percentage of ores from the Prince William Sound mines is nearly twice that of ores from the mines of southeastern Alaska.

REVIEW BY DISTRICTS.

PACIFIC COAST BELT.

SOUTHEASTERN ALASKA.[a]

Southeastern Alaska embraces the coastal strip lying between the British Columbia boundary and tide water, together with the Alexander Archipelago. This so-called "Panhandle" of the Territory was the scene of the first mining, and of the

[a] The account of mining developments here presented is largely taken from report on progress of investigations of mineral resources of Alaska, in 1905, by Alfred H. Brooks and others, Bull. U. S. Geol. Survey No. 284, 1906.

$80,000,000 worth of gold which Alaska has produced about $30,000,000 has been taken from southeastern Alaska. This province, while maintaining its supremacy as a lode-mining center, is far behind both the Yukon basin and the Seward Peninsula in its gold output.

The Panhandle has been divided into five districts or precincts, which, named from south to north, are Ketchikan, Wrangell, Sitka, Juneau, and Skagway. The first three contain only lode mines. The Juneau district has produced considerable placer gold and includes several placer mines of importance; and the producing mines of the Skagway district are confined to the placers of the Porcupine region, which were not operated in 1905.

Ketchikan district.—Though auriferous lodes are not uncommon in the Ketchikan region, and many of these are being carefully prospected, there were only two mines which were on a productive basis, though a number of others made some shipments of ores. The Miller mine, on the east side of Gravina Island, which has reached a depth of 100 feet, is equipped with a 5-stamp mill. The workings of the Puyallup mine, near Hollis, on Prince of Wales Island, have developed a well-defined and rich, though narrow, vein of free-milling ore. The ore has been treated on the property with a 5-stamp mill. Considerable development work was done on a number of other claims in the vicinity of Hollis, notably on the Crackerjack, the Flora and Nellie, the Dewdrop, and the Rose, but none of these have reached a commercially productive stage. Work has continued on the Valparaiso, near Dolomi. Development work was also done on the auriferous lode deposits of the eastern side of Dall Island.

During 1905 the most important advances in the mining industry in the Ketchikan district was in the exploitation of the copper deposits, which usually carry some gold. The ores are chalcopyrite and cupriferous pyrite, accompanied by magnetite, pyrrhotite, and other minerals. There was considerable mining of the copper deposits of the Kasaan Peninsula and of Niblack Anchorage, on the east side of Prince of Wales Island, and of those on Hetta Inlet on the west side of Prince of Wales Island. Most of the ores were shipped to Tacoma, but two smelters were put in blast on Prince of Wales Island about the end of 1905.

Wrangell district.—There was no gold produced in the Wrangell district during 1905 and but little prospecting. Some developments were made on copper properties on Duncan canal, but no shipments were made. The promising deposits of galena found on the mainland east of Wrangell in 1904 appear to have received little attention in 1905.

Juneau district.—The Treadwell group of mines, on Douglas Island, with its mills, aggregating 880 stamps, continues to be the most important enterprise of the Juneau district, as well as of the entire Territory. A depth of 1,200 feet has now been reached in the workings of this group, and there is no evidence of a decrease in size of the ore body, while in fact the output is increasing each year. The product of this group in 1905 was valued at $3,024,394. In Gold Creek basin the Ebner mine, with 15 stamps, and the Alaska-Juneau, with 30 stamps, were operated in 1905. The Alaska Perseverance Company continued its extensive developments on a property lying adjacent to the Alaska-Juneau, and has begun the installation of a 300-stamp mill. A small ledge of rich ore was developed at the head of Gold Creek under the name of Bull Consolidated Group. Some work was done on the Humboldt, the Hallam, and the Boston properties. The Jualpa Mining Company did some work on the Last Chance placer mine and the Silver Bow Hydraulic Mines Company operated the Nowell placer mine in Silver Bow basin. The Sheep Creek mine, south of Juneau, was operated during the first half of 1905.

Prospecting has continued on Admiralty Island, but no considerable progress at mine development was made. None of the mines at Port Snettisham, Sumdum Bay, or Windham Bay had any production in 1905, but some promising ore bodies were opened up.

A hydraulic elevator was installed on Windfall Creek, north of Juneau, and was operated for a part of the season. The Eagle River Mining Company operated its 20-stamp mill and continued development work on a very promising ore body. Considerable development work was done on several properties on the Yankee basin.

Excepting the Jualin mine, none of the mines at Berners Bay were operated in 1905. Had not these properties been involved in a legal tangle they would already have been large producers. The Jualin mine, with its 10-stamp mill, was a steady producer throughout the year and added considerably to the gold output.

Skagway district.—No commercial ore bodies have been developed in the Skagway district, but the placers of the Porcupine region have been producers, though they were not in operation during 1905. Most of the gold has been taken from Porcupine and McKinley creeks, but some work has also been done on Nugget Creek and Salmon River. The steep-walled character of the valley and the occasional floods have made some of these creeks expensive to work. It will probably require a company strong enough to control a large group of claims to operate in this district. Some important lode discoveries are reported from this region.

COASTAL REGION FROM CROSS SOUND TO ALASKA PENINSULA.

The beach placers between Lituya and Controller bays continue to be worked every year by individual prospectors, but the value of the annual output is probably less than $50,000. Two copper mines—the Bonanza and Gladhaugh—were in operation on Prince William Sound in 1905, and much prospecting was done on other properties. The ores are chiefly chalcopyrite, with which is associated pyrrhotite, iron pyrite, and marcasite. The ores often carry values of $1 to $5 in gold and small quantities of silver. Shipments are chiefly to Tacoma smelters.

Some promising quartz veins have been found on Ugak Bay, Kodiak Island. A mine with a 5-stamp mill was operated in 1905. The Apollo Consolidated mine, on Unga Island, long a large producer, was not operated in 1905. Beach placers on Kodiak, Popof, and other islands are worked in a crude way every year. The value of the entire output of this form of mining in 1905 is not believed to exceed $10,000.

COPPER RIVER BASIN.

The placers at the head of the Chitina and in the Chistochina district continue to be worked, in spite of the excessive cost of transportation. With the construction of a railway from Prince William Sound, for which the plans have been made, the placers of this province will undoubtedly develop more rapidly. The value of their annual output for 1905 is estimated to be about $300,000. Considerable prospecting was done in 1905 on the deposits of the Chitina copper belt, but their more systematic exploitation must await the completion of a railway from the coast. Several companies are in the field, which plan to build railways from Pacific tide water into the Copper River basin.

COOK INLET REGION.

Gold mining in this field is practically confined to the placers of the Sunrise district, at the northern end of the Kenai Peninsula. Some interest has been excited by the reported discovery of auriferous and cupriferous lodes at a number of different localities. These, being undeveloped, are not known to carry commercial values. The continuation of the construction of the Alaska Central Railway from Resurrection Bay to Turnagain Arm has encouraged the development of the mining interests.

The Kenai placers have been gold producers for about twelve years and the value of the annual output is probably now about $200,000. A large dredge was completed for use in this district in 1905 and several new hydraulic plants were also installed.

Some placer mining is done on Willow Creek, an eastern tributary of the Sushitna, and important discoveries of placer gold are reported to have been made in 1905 on Peters Creek, tributary to the Kahiltna, which flows into the Yentna, a westerly tributary of the Sushitna.

SEWARD PENINSULA.

The value of the estimated output of gold of the Seward Peninsula is $4,800,000, of which probably half was taken from the Nome region proper. This gold is all from placers, with the exception of the production of the Hurrah Quartz mine, near Solomon, at which 20 stamps were in operation throughout the year. The output of the peninsula was about $600,000 greater in 1905 than in 1904, and there was much activity in the construction of ditches and in the installation of mining machinery. Winter mining operations are very much on the increase, and probably 20 per cent of the production is taken out of the deep gravels during the winter months. An old beach line near Nome, which has been traced for over 8 miles, has been a large producer. The richest claims worked during the year are those on Little Creek, about 7 miles from Nome, where over $1,000,000 worth of gold was taken out of four claims. The Little Creek claims and the old beach deposits all lie in the so-called tundra belt. Their discovery has led to much activity in prospecting the gravels which underlie the tundra. It is now evident that the largest gold reserves of the peninsula lie in these gravel plain placers.

The introduction of dredges for gold recovery is an important step in the advancement of mining methods. In 1905 some dredges were successfully used in both the Nome and the Solomon regions. Where frozen gravels are encountered a dredge can be successfully employed only by first exposing a surface or face of the deposit, which then thaws rapidly by artificial thawing, as has been done in the Klondike.

During the summer of 1905 not less than 13 ditches were completed or under construction, with capacities varying from 1,200 to 2,000 miner's inches of water. The largest completed ditch is the Miocene, which, with feeders, has a total length of 50 miles. When the work of construction already inaugurated is completed there will be between 300 and 350 miles of ditch on the peninsula. Many of them, however, were built without any adequate knowledge of the water supply and will be almost worthless.

Nome region.—In the Nome region proper the Miocene Ditch Company, the Pioneer Company, and the Wild Goose Company were the largest operators; but many other companies were engaged in development work of various kinds. Two steam scrapers were installed on the beach near Nome. The beach sands, though they have mostly been worked over with rockers, still contain considerable gold, and the problem of economic handling of these deposits has not been easy to solve. It is necessary that the equipment should be readily moved from one point to another, for the gold-bearing sands are usually not over 3 to 6 feet deep.

Iron Creek and Cripple River regions.—In the Iron Creek region and in the Cripple River region some mining was done, but most of the activities were directed toward ditch building.

Solomon region.—The Solomon region was developed by the construction of ditches and also by the introduction of dredges and steam shovels. Of special interest is the installation of a pumping plant to raise water for hydraulic mining. The Hurrah Quartz mine is being steadily developed, some new machinery being installed during 1905.

Council region.—The Wild Goose Company continues to be the largest operator in the Council region. This company has been very successful in the use of hydraulic elevators. Here, too, a pumping plant is being installed for furnishing water for hydraulic mining. A dredge was operated during 1905 near the mouth of Ophir Creek. Though most of the gold production of the Council region is taken from Ophir Creek, yet mining was also done on Warm, Goldbottom, Elkhorn, and Camp creeks. Daniels Creek continues to be a good producer, and with the lengthening of the Topkok Ditch, its output will undoubtedly be increased.

Teller region.—In the Teller region mining in 1905 was almost entirely confined to Gold Run and Bering creeks. Mining activities in the Kougarok were largely confined to ditch building, but there was nevertheless a considerable gold output.

Fairhaven region.—In the Fairhaven district, embracing the northeastern part of the peninsula, the most important discovery was the rich bench gravels of Candle Creek. Considerable mining was also done in the Inmachuk basin. The total output of the district for 1905 is estimated to have been between $250,000 and $300,000, of which about two-thirds was taken out of the winter dumps. About 50 claims were worked during the winter and 15 during the summer months. Two hundred men were engaged in mining during the winter and 100 during the summer months, while about 100 were prospecting.

KOBUK BASIN.

A little gold mining has been carried on for several years in this northern field, and claims have been worked on Dahl and Shunguak creeks, tributaries to the Kobuk. The estimated value of the production for 1905 is $5,000, and about 30 men were engaged in prospecting and mining.

YUKON BASIN.

In 1905 the Yukon basin rose to first importance as a gold producer, with an output valued at $6,900,000, compared with an output in 1904 valued at $1,300,000. This increase is to be credited entirely to the Fairbanks district.

Fairbanks district.—The gold-producing creeks of the Fairbanks district lie, with an area including about 300 square miles, chiefly within the Tanana basin, and are all not over 25 miles from Fairbanks, a town of 2,500 to 3,000 inhabitants. A railway about 26 miles in length now connects some of the more important creeks with navigable waters on the Tanana.

The pay streak[a] varies from 1 to 12 feet in thickness, and carries from $2.75 to $10 to the yard. An overburden of gravel from 10 to 60 feet thick is covered by a layer of muck, which in some places reaches 70 feet in thickness, but is usually not more than a few feet thick. On account of the depth of the gravels open-cut mining is relatively little used. The alluvium is usually frozen, and drifting with steam points is the most commonly employed mining method. Mining is done in winter, the accumulated dumps being washed out in the summer. Fairbanks Creek is the second largest producer, its output in 1905 exceeding $1,000,000. The pay streak on the creek averages 5½ feet in thickness and ranges from 4 to 200 feet in width. Considerable mining was done in 1905 on Pedro, Gilmore, Goldstream, Dome, and Esther creeks, but the output was small compared with that of Fairbanks Creek. Cleary Creek is by far the greatest producer, its output for 1905 being estimated to have a value of about $4,500,000. The average value of the pay streak appears to be about $10 to the cubic yard, with a thickness of about 5 feet.

Considerable prospecting was done in the region lying 20 to 40 miles southeast of Fairbanks. Promising deposits were found in the Salcha basin and on Tenderfoot Creek, but little actual mining was accomplished. Worthy of note also is the reported discovery of rich placers in the headwater region of the Kantishna River, a southerly

[a] In considering the gold tenor and the dimensions of pay streaks, it must be remembered that these are variants with the cost of mining. Under existing conditions in the Fairbanks district, probably no deep gravels can be mined whose tenor is less than $2.50 to the cubic yard. A reduction in cost is being gradually effected, and this will make it possible to exploit wider pay streaks that average less to the cubic yard.

tributary of the Tanana. Placers are also reported to have been found in the basin of the Delta River, which joins the Tanana from the south, 200 miles above Fairbanks.

Rampart district.—A triangular area lying west of Fairbanks and included between the Yukon and the Tanana valleys is usually called the Rampart district. Several small hydraulic plants were installed and some ditches dug in this field during 1905. New discoveries of placers were made on Pioneer Creek, both in the stream bed and on the benches. Promising prospects were also found on Deadwood and Eureka creeks. Probably the most important fact brought out in this work is that the benches of this region carry commercial placers. The output of the district is estimated at about $200,000, about one-third of which was taken out during the winter months.

Birch Creek district.—Under the name Birch Creek district is embraced a gold-producing area lying about 25 miles from the Yukon and chiefly tributary to a creek of the same name. The output is estimated to have been about $300,000, mostly taken from the placers of Deadwood, Mastodon, and Eagle creeks. Noteworthy is the discovery of gold on a bench of Mastodon Creek and in the floor of Switch Creek.

Fortymile district.—The Fortymile district, embracing an ill-defined gold-bearing area lying adjacent to the international boundary and chiefly drained by Forytmile Creek, is estimated to have produced $215,000 in gold during 1905, or about the same as in 1904. Wade, Chicken, and Lost Chicken creeks were the chief producers; but there was also some mining on Mosquito Fork, Buckskin, Montana, North Fork, South Fork, and American creeks. In the same general region Woodchopper and Fourth of July creeks continued to be small producers.

Koyukuk district.—The Koyukuk district lies north of the Arctic Circle and is drained by the Koyukuk River. Though its placers are rich, the isolation of the district has prevented its rapid development. It is reported that in the summer of 1905 about 130 men were working on 28 claims in this district and that the output was about $200,000.

ARIZONA.

By V. C. Heikes.

PRODUCTION.

The metal production in the Territory of Arizona for 1905, as reported by 134 producers, including 12 placers, totaled $40,252,793. Of this total the gold yield was 135,412 fine ounces, valued at $2,799,214, and the silver 2,605,712 fine ounces, which at the average commercial price, gave a value to the product of $1,573,850, or a total value for the precious metals of $4,373,064. This is $430,771 less than the value of the 1904 production, and the loss is attributed entirely to the gold decrease, which was due to the fact that for technical reasons certain mines were worked only a portion of the year. The silver product increased through the renewed operations of the Commonwealth mine in the Turquoise district of Cochise County.

During 1905 the tonnage of ore mined, milled, and smelted amounted to 2,678,059 short tons, averaging per ton $15.01 for the gold, silver, copper, lead, and other metals. A comparison of these figures with the corresponding ones for 1904 shows that the value of the total metal output increased $10,434,498. The ore tonnage increased 372,121 short tons, and the total value per ton increased from $12.93 in 1904 to $15.01 in 1905, or $2.08 per ton, due largely to the copper content of the ores. In 1905 the ore averaged in gold $1.03 and in silver 59 cents, an average total value for both metals of $1.62 per ton; and in 1904 the average value of the ore was $1.51 in gold and 57 cents in silver, or an average total value for both metals of $2.08 per ton, a decrease in 1905 for gold of 48 cents per ton and an increase for silver of 2 cents per ton. The increases and decreases in the metal output of the territory for 1905 are as follows: Gold decreased 32,862 fine ounces and $679,318 in value; silver increased 290,772 fine ounces and $248,547 in value; copper increased 28,937,635 pounds and $10,698,183 in value; lead increased 3,160,943 pounds and $154,349 in value; other metals, which include zinc and iron, increased in production and $12,737 in value.

The statement of production for 1904 and 1905 figured at each year's average commercial price is as follows:

Production of gold, silver, and associated metals in Arizona in 1904 and 1905.

Metal.	1904.		1905.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold........fine ounces..	168,274	$3,478,532	135,412	$2,799,214	− 32,862	− $679,318
Silver..............do....	2,314,940	1,325,303	2,605,712	1,573,850	+ 290,772	+ 248,547
Copper ....pounds..	199,481,044	24,935,131	228,418,679	35,633,314	+28,937,635	+10,698,183
Lead ....do....	1,779,967	77,874	4,940,910	232,223	+ 3,160,943	+ 154,349
Other metals..............	....	1,455	....	14,192	....	+ 12,737
Total value	....	29,818,295	....	40,252,793	....	+10,434,498

Production of ore in Arizona in 1904 and 1905.

	1904.		1905.		Increase.	
	Short tons.	Value per ton.	Short tons.	Value per ton.	Short tons.	Value per ton.
Ore output..........................	2,305,938	$12.93	2,678,059	$15.01	372,121	$2.08

GOLD.

The total gold production for the Territory amounted to 135,412 ounces, valued at $2,799,214, in 1905, as against 168,274 ounces, valued at $3,478,532, in 1904, a decrease of 32,862 ounces in quantity and of $679,318 in value. The greater part of the year's supply came from Yavapai County, with Mohave, Cochise, and Yuma counties following in the order of their yield. Increases in gold are recorded for all counties in the Territory except Mohave, Yavapai, and Yuma The decrease of gold in these counties is partly accounted for through mining companies restricting the ore output, awaiting the blowing in of the new custom smelter at Humboldt, in Yavapai County. The reports also show that certain mines producing siliceous ores, receiving treatment by the amalgamation and the cyanide process, reported a number of tons less than they did in 1904. In 1905 the principal part of the gold came from siliceous ores, but nevertheless, this class of ore suffered a decrease of 39,639 ounces, as did the lead ores, which decreased 3,415 ounces. Increases are recorded in placers to the extent of 1,249 fine ounces; copper ore, 8,128 fine ounces; copper-lead ore, 98 fine ounces, and lead-zinc ore, 717 fine ounces. These differences in the kinds of ore will be found in the table which follows.

NOTE.—In the following tables of this report the basis of calculation of values for the various metals in 1905 is as follows: Gold, $20.671834 per fine ounce; silver, 60.4 cents per fine ounce; copper, 15.6 cents per pound; lead, 4.7 cents per pound; zinc, 5.9 cents per pound; platinum, $17 per crude ounce.

Source of gold production in Arizona by kinds of ore in 1905 by counties.

[Fine ounces.]

County.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Mixed ores.		Total.
					Copper-lead ore.	Lead-zinc ore.	
Cohise		4,617	9,690	6,513			20,820
Coconino and Maricopa	34	806					840
Gila		286	2,181				2,467
Graham		3	2,136		97		2,236
Mohave		25,725	532		15		26,272
Pima	677	100	50	2			829
Pinal	26	516	152				694
Santa Cruz		35	23		9		67
Yavapai	1,287	21,650	40,884	2,755		717	67,293
Yuma	40	13,834	20				13,894
Total	2,064	67,572	55,668	9,270	121	717	135,412

Comparison of these totals for 1905 with the gold output for 1904 is as follows:

Production of gold in Arizona in 1904 and 1905 by kinds of ore.

[Fine ounces.]

Year.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Mixed ores.		Total.
					Copper-lead ore.	Lead-zinc ore.	
1904	815	107,211	47,540	12,685	23		168,274
1905	2,064	67,572	55,668	9,270	121	717	135,412

SILVER.

The silver yield amounted to 2,605,712 ounces, valued at $1,573,850, in 1905, as against 2,314,940 ounces, valued at $1,325,303, in 1904, an increase of 290,772 ounces in quantity and of $248,547 in value. The increase was greatest in Cochise County, due to the increased output of the Tombstone mines. In Gila County the increase came from ores treated by the Old Dominion Copper Company. Santa Cruz County records an increase through the opening of the Mowry mines in the Patagonia district. Silver increased in all kinds of ore, as is shown in the table following:

Source of silver production in Arizona by kinds of ore in 1905, by counties.

[Fine ounces.]

County.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Mixed ores.		Total.
					Copper-lead-zinc ore.	Copper-lead ore.	
Cochise		308,104	610,478	526,712	240	7,778	1,453,312
Coconino and Maricopa	4	45					49
Gila		17,442	67,540				84,982
Graham		5,024	47,167			5,000	57,191
Mohave		64,198		8,538		800	73,536
Pima	140	60	40,963	700		7,500	49,363
Pinal	3	3,160	6,686	4,000			13,849
Santa Cruz		1,400		13,200		60,390	74,990
Yavapai	156	37,189	707,898	34,780		6,684	786,707
Yuma	3	5,330		6,400			11,733
Total	306	441,952	1,480,732	594,330	240	88,152	2,605,712

Comparison of these totals for 1905 with the silver output for 1904 is as follows:

Production of silver in Arizona in 1904 and 1905, by kinds of ore.

[Fine ounces.]

Year.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Mixed ores.		Total.
					Copper-zinc ore.	Copper-lead ore.	
1904	....	283,878	1,463,431	566,331	....	1,300	2,314,940
1905	306	441,952	1,480,732	594,330	240	88,152	2,605,712

COPPER.

The rise in the price of copper has encouraged prospecting and the opening up of low-grade mines in Arizona. During 1905 the price rose from 14½ cents to 19 cents, the average being 15.6 cents per pound. The output of copper for the Territory increased from 199,481,044 pounds, valued at $24,935,131 in 1904, to 228,418,679 pounds, valued at $35,633,314 in 1905, an increase of 28,937,635 pounds in quantity and of $10,698,183 in value.

The greatest production within the Territory was around Bisbee, in the Warren mining district, of Cochise County. The copper output of Cochise County increased from 90,850,611 pounds, valued at $11,356,326, in 1904, to 108,498,440 pounds, valued at $16,925,757 in 1905, an increase of 17,647,829 pounds in quantity and of $5,569,431 in value. At Bisbee are located the largest producers, the Copper Queen Consolidated, the Calumet and Arizona, and other large mines developing into producers.

Comprising the districts of Greenlee and Copper Mountain, or Clifton and Morenci camps, which are principally responsible for its output during the year, Graham County ranks second in the list of copper producers. The output, however, suffered for the reason that the largest producer, the Arizona Copper Company, was compelled to close down twenty days during the spring freshets, and the Shannon Copper Company was idle about twenty-five days. The output decreased in quantity from 59,537,295 pounds, valued at $7,442,162, in 1904, to 53,939,212 pounds, valued at $8,414,517, a decrease in quantity of 5,598,083 pounds, but an increase of $972,355 in value, due to the higher market price for the metal.

Yavapai County ranks third in copper production, the credit for the greatest part of the output going to the United Verde mine, located at Jerome camp, in the Verde district. The production rose from 30,826,286 pounds, valued at $3,853,286, in 1904, to 34,279,734 pounds, valued at $5,347,638, in 1905, an increase of 3,453,448 pounds in quantity and of $1,494,352 in value. This production might possibly have been greater but for the accident at the United Verde mine toward the end of March. A disastrous explosion occurred, caused by water breaking into the old workings that have been on fire for the last six years.

Holding fourth place in production is Gila County, with Globe Camp and district as the center of activity. The Old Dominion mine is responsible for the largest part of the output. The increase for the county is from 14,677,561 pounds, valued at $1,834,695, in 1904, to 24,991,794 pounds, valued at $3,898,720, in 1905, an increase in quantity of 10,314,233 pounds and in value of $2,064,025.

Pima County deserves credit for having doubled its output of copper, due largely to the production made by the Imperial Copper Company. Pinal County is making great strides, and increased its production more than threefold in 1905.

LEAD.

The lead produced in Arizona shows an increase from 1,779,967 pounds, valued at $77,874, in 1904, to 4,940,910 pounds, valued at $232,223, in 1905, an increase of 3,160,943 pounds in quantity and of $154,349 in value. This increase in output has been general in all the lead-producing counties except Pima. The Tombstone district, in Cochise County, contributed the greatest quantity of lead, which came from the properties of the Tombstone Consolidated Mines Company. The other counties in which large increases are recorded are Graham, Santa Cruz, Yavapai, and Mohave.

ZINC.

The zinc produced in the Territory in 1905 came from one property in Yavapai County. The yield is expected to be greater in this county during 1906, and the total product in the Territory is expected to be increased through production from properties in the Wallapai district of Mohave County.

PROGRESS OF MINERAL INDUSTRY IN ARIZONA IN 1905.

The prominent feature of progress in 1905 was the starting of a number of new independent smelting enterprises, with the additions made to the great smelters already established, which were necessary to keep pace with the steadily increasing volume of ore from the mines. Competition was very keen during the year, caused by several small plants in the Territory and New Mexico entering the field for custom ores of lead and copper. The most important event in smelter building is the erection of the Arizona Smelter, at Humboldt, in Yavapai County. This lead and copper plant will have a daily ore capacity of 800 tons, and is expected to start operations about May, 1906. In the same county, at Mayer, was constructed a 250-ton copper smelter by the Treadwell Company; and a 125-ton reduction plant, using a volatization process, is being completed by the Rigby Mining and Reduction Company.

In Graham County, at Morenci and Clifton, the Detroit Copper Company, and notably the Arizona Copper Company and Shannon Copper Company, added extensive improvements to their reduction works. In Cochise County the Benson Copper Smelter, owned by the Southwestern Smelting and Refining Company, was idle; at Naco, the Mitchell Smelting Company has arranged for ground on which to build a copper plant; the Copper Queen Company, at Douglas, added 2 furnaces to their plant, and the Calumet and Arizona, located at the same place, completed additions which increased the capacity of the smelting plant. In Yuma County the Valenzuella Copper Company commenced the construction of a small smelter upon its properties in the River Range. At the town of Yuma an ore-sampling works is being erected by the newly organized Arizona Sampling and Smelting Company. In Pima County a concentrating mill and furnace, with initial capacity of 300 tons a day, will be built by the Imperial Copper Company, at Silver Bell. In Pinal County the Florence Smelting and Mining Company and the Kelvin Reduction Company, in the Mineral Hill district, near Kelvin, are preparing to reduce ores, the former company expecting to erect a copper smelter of 50 tons daily capacity. At Christmas (in Gila County), 10 miles from Winkelman, the terminus of the Phoenix and Eastern Railroad, the Saddle Mountain Mining Company erected a copper smelter of 150 tons daily capacity. The ore is self-fluxing, and for this reason the plant has been capable of handling upward of 200 tons daily. At Helvetia, in Pima County, the Helvetia Copper Company expected to blow in the latter part of the year a 200-ton copper smelter. The Mowry Mines Company, in the Patagonia district, of Santa Cruz County, started up a lead smelter of 100 tons daily capacity, operating on lead ores mined entirely from its own properties. Mohave County mines were benefited by the erection of a lead smelter at Needles, Cal., by the Arizona and Mexican Mining and Smelting Company, operating its own lead mines at Stockton, in Mohave County, and buying custom ore. Diamond drill operations have been successful in revealing bodies of ore, notably at Bisbee, on the property of the Pittsburg and Duluth. In Yavapai County 3 drills were working at Jerome, and preparations were made for similar work by the American Development Company, near Mayer.

Arizona has 13 counties. From 11 of these counties mine operators reported production of metals in 1905. Records show 211 mining districts in the Territory. Fifty-eight of these districts have a production credited to them for 1905.

In the following section a brief review is given of each of the productive counties.

Production of gold, silver, copper, lead, and other metals in Arizona in 1905, by counties.

County.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*		*Pounds.*	
Cochise	20,820	$430,388	1,453,312	$877,800	108,498,440	$16,925,757
Coconino and Maricopa	840	17,634	49	30	....	....
Gila	2,467	50,997	84,982	51,329	24,991,794	3,898,720
Graham	2,236	46,222	57,191	34,543	53,939,212	8,414,517
Mohave	26,272	543,090	73,536	44,416	30,399	4,742
Pima	829	17,137	49,363	29,815	5,954,770	928,944
Pinal	694	14,346	13,849	8,365	714,980	111,537
Santa Cruz	67	1,385	74,990	45,294	9,000	1,404
Yavapai	67,293	1,391,070	786,707	475,171	34,279,734	5,347,638
Yuma	13,894	287,215	11,733	7,087	350	55
Total	135,412	2,799,214	2,605,712	1,573,850	228,418,679	35,633,314

County.	Lead.		Other metals.[a]	Total value.
	Quantity.	Value.		
	Pounds.			
Cochise	2,677,980	$125,865	....	$18,359,810
Coconino and Maricopa	....	....	....	17,394
Gila	....	....	....	4,001,046
Graham	800,000	37,600	....	8,532,882
Mohave	112,266	5,277	....	597,525
Pima	50,388	2,368	....	978,264
Pinal	3,500	165	$1,771	136,184
Santa Cruz	338,840	15,925	....	64,008
Yavapai	697,806	32,797	12,421	7,259,097
Yuma	260,130	12,226	....	306,583
Total	4,940,910	232,223	14,192	40,252,793

[a] Iron and zinc.

The following table is prepared for the purpose of showing the increase and decrease in 1905 of the metals produced, by quantity and value, as compared with the production in 1904:

Increase (+) and decrease (−) in production of metals in Arizona in 1905 as compared with 1904, by counties.

County.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*		*Pounds.*	
Chochise	+ 1,981	+$40,951	+300,846	+$218,013	+17,647,829	+$5,569,431
Coconino and Maricopa	+ 641	+ 13,250	− 1,731	− 990	− 333,754	− 41,719
Gila	+ 2,301	+ 47,566	+ 75,311	+ 45,793	+10,314,233	+ 2,064,025
Graham	+ 19	+ 393	+ 13,228	+ 9,374	− 5,598,083	+ 972,355
Mohave	− 1,003	− 20,734	− 13,246	− 5,267	+ 28,919	+ 4,557
Pima	+ 336	+ 6,946	+ 6,311	+ 5,168	+ 2,915,551	+ 549,041
Pinal	+ 482	+ 9,963	+ 9,367	+ 5,799	+ 528,342	+ 88,207
Santa Cruz	+ 67	+ 1,385	+ 69,725	+ 42,280	− 18,000	− 1,971
Yavapai	−30,122	−622,677	−166,915	− 70,777	+ 3,453,448	+ 1,494,352
Yuma	− 7,564	−156,361	− 2,124	− 846	− 850	− 95
Total	−32,862	−679,318	+290,772	+ 248,547	+28,937,635	+10,698,183

County.	Lead.		Other metals.	Total value.
	Quantity.	Value.		
	Pounds.			
Cochise	+1,878,068	+$90,869	− $26	+$5,919,238
Coconino and Maricopa				− 29,459
Gila				+ 2,157,384
Graham	+ 800,000	+ 37,600		+ 1,019,722
Mohave	+ 106,230	+ 5,013		− 16,431
Pima	− 127,087	− 5,397		+ 555,758
Pinal	+ 166	+ 19	+ 1,688	+ 105,676
Santa Cruz	+ 300,985	+ 14,268	− 5	+ 55,957
Yavapai	+ 199,901	+ 11,014	+11,080	+ 822,992
Yuma	+ 2,680	+ 963		− 156,339
Total	+3,160,943	+154,349	+12,737	+10,434,498

The following table shows the tons of ore sold or treated, by counties; the number of deep mines selling or treating ore; the average total value per ton, and the average value per ton in gold and silver:

Tons of ore sold or treated, number of deep mines producing, and tenor of ores, in 1904 and 1905, by counties.

County.	Total tons of ore sold or treated.		Number of deep mines producing.		Average total value per ton.		Average value per ton in gold and silver.	
	1905.	Increase (+) or decrease (−) compared with 1904.	1904.	1905.	1904.	1905.	1904.	1905.
	Short tons.	*Short tons.*						
Cochise	950,765	+263,998	14	19	$18.11	$19.31	$1.53	$1.38
Coconino and Maricopa	2,740	+ 1,287	3	2	32.25	6.09	4.37	6.09
Gila	241,328	+141,227	11	10	18.42	16.58	.08	.42
Graham	952,509	− 5,510	7	9	7.93	8.96	.07	.08
Mohave	52,712	+ 5,192	13	21	12.92	11.34	12.91	11.14
Pima	37,186	+ 35,318	7	9	22.62	25.93	13.89	.86
Pinal	11,965	+ 11,000	5	10	31.61	11.34	7.20	1.85
Santa Cruz	1,508	+ 1,047	3	3	17.46	42.45	6.54	30.95
Yavapai	364,697	− 74,925	34	33	14.64	19.83	5.82	5.04
Yuma	62,649	− 6,513	7	6	6.69	4.88	6.53	4.68
Total	2,678,059	+372,121	104	122	12.93	15.01	2.08	1.62

The total tonnage and value of ore sold or treated in each county of Arizona during 1905, the concentrates and the gold-silver bullion produced, and the quantity and value of old tailings treated are shown in the following table:

Tonnage and value of ore, concentrates and bullion produced, and old tailings treated in Arizona in 1905.

County.	Total ore.		Concentrates produced.		Gold-silver bullion produced.		Old tailings treated.	
	Quantity.	Value.	Quantity.	Gold and silver value.	Quantity.	Value.	Quantity.	Gold and silver value.
	Short tons.		*Short tons.*		*Fine ounces.*		*Short tons.*	
Cochise	950,765	$18,359,810	12,914	$7,489	4,065	$5,282	69,980	$143,167
Coconino and Maricopa	2,740	16,689			851	16,865	140	644
Gila	241,328	4,001,046	7,764	3,182	36	562		
Graham	952,509	8,532,882	136,345	70,608				
Mohave	52,712	597,525	264	14,422	39,373	520,723	4,000	16,000
Pima	37,186	964,184			160	2,103		
Pinal	11,965	135,645	33	10,053	32	650		
Santa Cruz	1,508	64,008						
Yavapai	364,697	7,232,398	8,952	351,881	38,068	518,692	42,793	158,128
Yuma	62,649	305,751	52	1,280	20,557	287,432		
Total	2,678,059	40,209,941	166,324	458,915	103,142	1,352,309	116,913	317,939

The table following gives the number of mines classified according to their chief product in 1905.

Number of mines classified by chief product in Arizona in 1905, by counties.

County.	Nonproducing mines.	Mines reporting product.	Gold placer mines.	Deep mines.					Total.
				Gold.	Silver.	Copper.	Lead.	Zinc.	
Cochise	71	19	....	1	5	10	3	....	90
Coconino and Maricopa	49	4	2	1	1	....	....	....	53
Gila	37	10	....	1	1	8	....	....	47
Graham	49	9	....	....	2	6	1	....	58
Mohave	88	21	....	9	7	....	5	....	109
Pima	65	11	2	1	....	6	2	....	76
Pinal	55	11	1	2	2	6	....	....	66
Santa Cruz	46	3	....	....	1	....	2	....	49
Yavapai	296	39	6	14	5	8	5	1	335
Yuma	35	7	1	3	....	1	2	....	42
Total	791	134	12	32	24	45	20	1	925

PRODUCTION BY INDIVIDUAL COUNTIES.

COCHISE COUNTY.

The mining developments which have taken place within five years have made this county the richest in the Territory in value of mineral production. Warren district is the principal source of the mineral wealth. The greatest ore tonnage is produced from the properties of the Copper Queen Consolidated and the Calumet and Arizona companies. The ore is reduced in the smelters belonging to these companies, at Douglas, 28 miles from the mines. Though only four years old, this town now has a population of 8,000.

In 1902, Phelps, Dodge & Co., controlling the Copper Queen and other interests in the county, became dissatisfied with the existing railway transportation, and built the El Paso and Southwestern Railroad, connecting Bisbee directly with El Paso, Tex., 240 miles away. Another notable event during the early part of 1905 was the transfer to Phelps, Dodge & Co. of the El Paso and Northeastern Railroad and its allied properties. In acquiring this road the company has facilitated the operation of its copper mines and smelters in Arizona and Sonora, Mexico, as the road taps the Dawson coal fields of Colfax, N. Mex. This enables the Phelps, Dodge Company to utilize these coal deposits more advantageously than heretofore, and to supply coal and coke to its own road and to nearly all the smelters of the Southwest. Its tracks begin at the coal fields and end at the mines and smelter.

Developments and production were the greatest in the Tombstone, Turquoise, Cochise, and Bisbee or Warren districts.

The smelter of the Southwestern Smelting and Refining Company, at Benson, was idle, and the erection of a smelter at Naco, by the Mitchell Smelting Company, was continuously talked of during the year, but did not materialize.

This county leads in the total value of its output for 1905. The ores sold or treated, amounted to 950,765 short tons, valued at $18,359,810, as against 686,767 short tons, valued at $12,440,572 in 1904. The increase is 263,998 short tons in quantity and $5,919,238 in value. The total average value per ton was $18.11 in 1904; the value was greater in 1905 by $1.20.

Production of gold, silver, and associated metals, in Cochise County, Ariz., in 1904 and 1905.

	1904.		1905.		Increase (+) or decrease (−)	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold........fine ounces..	18,839	$389,437	20,820	$430,388	+ 1,981	+ $40,951
Silver..............do....	1,152,466	659,787	1,453,312	877,800	+ 300,846	+ 218,013
Copper..........pounds..	90,850,611	11,356,326	108,498,440	16,925,757	+17,647,829	+5,569,431
Lead...............do....	799,912	34,996	2,677,980	125,865	+ 1,878,068	+ 90,869
Other metals............	....	26	....	....	....	− 26
Total...............	....	12,440,572	....	18,359,810	....	+5,919,238

Production of ore in Cochise County, Ariz., in 1905.

	1904.		1905.		Increase.	
	Short tons.	Value per ton.	Short tons.	Value per ton.	Short tons.	Value per ton.
Ore output........................	686,767	$18.11	950,765	$19.31	263,998	$1.20

The source of the precious metals by different kinds of ore is given in the following table:

Source of gold and silver in Cochise County, Ariz., 1904 and 1905, by kinds of ore.

[Fine ounces.]

Metal.	Year.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Copper-lead-zinc ore.	Copper-lead ore.	Total.
Gold	1904	29	1,653	8,740	8,417	....	....	18,839
	1905	....	4,617	9,690	6,513	....	....	20,820
Silver...............	1904	....	72,982	586,594	492,890	....	....	1,152,466
	1905	....	308,104	610,478	526,712	240	7,778	1,453,312

Bisbee or Warren district.—In addition to the operations of the large producers, several other concerns, notably the Saginaw Development Company, the Denn-Arizona Development Company, and the Shattuck-Arizona Copper Company, were prosecuting very satisfactory developments. These companies practically cover all the ground in the Bisbee district that is now under active development. Another producer, the only one of its kind in the district, is the Easter Sunday, which has always shipped in a small way a siliceous gold ore used at the smelters for converter lining. The present ores of the district are largely composed of copper minerals, chalcocite, and chalcopyrite, and come from the lower levels of the mines.

At the Copper Queen properties improvements were made by the installation of several large engine blowers and a large air compressor. The old smelter plant of the company was cleaned up and immense quantities of flue dust were sent to the Douglas smelter, briquetted, and mixed with the furnace charge. From the mines the ore is elevated to the surface through 5 shafts, the Czar, Gardner, Holbrook, Lowell, and Spray. Two others in course of development are the Cuprite and the Sacramento. The main producing shaft is the Holbrook. It has 6 compartments and is 500 feet deep; the Lowell is 1,200 feet deep. The number of men employed at the mines on surface and underground is 2,500; the ore hoisted daily is from 1,500 to 1,800 tons. Considering all the development work necessary, the ore output per man per shift is about 3 tons, miners doing their own timbering. The miners' wages are $3.50 per day. The lowest amount paid Mexicans is $1.50 per day. The Copper Queen smelter is equipped with 8 blast furnaces and 6 converters, capable of treating about 2,500 tons of mixed ore charge per day. The method of mixing ore and fluxes is by dumping into pits, four of which are 800 feet and one 1,000 feet long by 50 feet wide and 12 feet deep. These pits are between the lines of railroad, and as each class of material is unloaded from the cars it is leveled by great plows drawn by locomotives. Two steam shovels of the Thew make are in constant operation, raising the ore to small dump cars, which are electrically hauled to the furnace-charging floor. The company buys some custom ores. About 1,200 men are employed in the smelter.

The Calumet and Arizona has 5 blast furnaces for copper ores. The capacity is about 1,600 tons per day. The product of the smelter is high-grade blister copper. This company burns petroleum in its smelter power plant. Water is obtained from artesian wells. This important discovery was made in the latter part of the year, when the company began boring near the smelter for artesian water, and encountered a flow at a depth of 400 feet. An additional depth of 50 feet increased the flow materially, and a supply of 250 gallons per minute is now available. The Calumet and Arizona properties consist of the Calumet and Pittsburg Mining Company, the Lake Superior and Pittsburg Mining Company, the Pittsburg and Duluth Mining Company, and the Junction Mining Company. Since beginning operations in 1899 the Calumet and Arizona has sunk 6 vertical shafts to an average depth of 1,200 feet. Many miles of drifting have been done, both in ore and in barren limestones. At the Calumet and Pittsburg, development has been going on slowly in the Briggs shaft because the water is so troublesome. This shaft of 4 compartments is about 1,100 feet deep. A second shaft, known as the Hoatson shaft, was started during the early part of the year on the Del Norte claim, about 3,000 feet from the Briggs shaft. The shaft was sunk 1,000 feet, partly in a very hard crystalline limestone. Records show that during the last three months of the year the shaft was sunk 157 feet, 120.5 feet, and 162 feet, respectively. The Lake Superior and Pittsburg has been developed by 3 shafts. The Cole shaft, formerly known as No. 2, cuts high-grade ore bodies at 1,100 feet in the shaft. This mine has been producing since October, 1905. About 200 tons of ore are hoisted daily. Through the Cole shaft will be handled the production of the adjacent property, the Pittsburg and Duluth. This property has been in course of development about three years. On the Black Bear claim it has a 3-compartment shaft 1,350 feet deep and connected with the Cole shaft by drifts 4,500 feet long. In a short time drifts from the 1,100-foot level of the Cole shaft will cut Pittsburg and Duluth ground, and at 100 feet deeper than the present workings. The Junction Mining Company carries on development through a 5-compartment shaft. Connection was secured with the Briggs shaft upon the 770-foot level, which meets the 910-foot level of the Calumet and Pittsburg. The Pittsburg and Duluth Company is the third largest producer of the group. All these mines are equipped with heavy plants for pumping and hoisting. The smelting for the group is all done at the works of the Calumet and Arizona, at Douglas. About 1,200 men are employed at the mine.

California district.—This district, with Paradise camp as the center, is located in the Chiricahua Mountains tributary to Douglas and embraces a territory 4 miles in width by 18 miles in length. The average elevation is 5,500 feet. One property shipped from the district in 1905. From developments in hand the production in 1906 will be worthy of mention. The operators of the Oregon group of claims made a small shipment of ore carrying silver, copper, and lead. Important developments are in progress 1½ miles west of Paradise by the Chiricahua Development Company, which has sunk a 3-compartment shaft to a depth of 425 feet. Other properties being developed are 39 claims joining the Chiricahua group on the west and owned by the Manhattan Development Company. The Savage Copper Company has claims located near the New Mexico line, Rodeo being the nearest railroad point. A 60-ton matting furnace is being erected by the company for a reduction of the ores from this and other properties.

Cochise district.—Johnson is the main camp of the district and is located 9 miles west of Cochise and 6 miles north of Dragoon, stations on the Southern Pacific Railroad. The ores of this camp are of copper, with considerable carbonate ore of good grade near the surface and sulphides below the 100-foot depth. The deepest workings are on the claims operated by the Arizona Consolidated Mining Company, operating from 2 incline shafts 275 and 307 feet deep. The Peabody mine, operated by the Dragoon Mining Company, is considered one of the best-developed mines in the district and is 325 feet deep. It was a producer in 1902 and 1903 and is likely to be on record in 1906. Developments were made on the Copper King claim and a small shipment sent to the smelters for test purposes. The Copper Chief claim is being developed by the Arizona and Michigan Development Company and the Empire claims by the Empire Copper and Gold Mining Company. Water level has not been reached in any of the properties. In this district the tungsten minerals, wolframite and hübnerite, occur in veins and in alluvium in the granite near Dragoon, and are washed and screened by means of rockers and dry washers from the sands during the wet seasons. This ground is patented and held mostly by the Primos Chemical Company.

Teviston district.—The Gold Nugget Mining Company owns 21 mining claims about 14 miles south of Bowie station, on the southern Pacific Railroad. The developments consist in shafts, tunnels, and test pits aggregating 1,500 feet. A mill consisting of 5 stamps and 1 concentrator was operated up to August, when for lack of funds the property closed down. The mine during development work has been a producer for several years.

Tombstone district.—This district is the center of an extensive area of mining activity. To the south is the Warren district, in which Bisbee is located; 16 miles east is the Turquoise district, with Pearce, Middlemarch, Black Diamond, and Gleeson camps, and 40 miles north is the Cochise district, or Johnson's Camp. Two railroads, the Southern Pacific and the El Paso and Southwestern Railway, have stations at Fairbank, with which Tombstone is connected by a branch line of the El Paso Railway. The ores produced in the district are mostly oxidized in character and contain lead, with appreciable quantities of gold and silver, the latter making up the larger part of the total value. Another class of ore contains manganese in large quantities, carrying some silver, and is sought after for flux by smelters. The Tombstone Consolidated Mines Company (Limited) has within the last few years secured title to a large number of valuable claims located on all the known fissure veins in the district, as well as all the important mines on anticlinal deposits. Since this acquisition the company has been developing below the water level and has the shaft completed to a depth of 886 feet. This will be continued 114 feet farther, making the depth 1,000 feet, as soon as additional pumps are installed. Water has always been a great problem to deal with in these properties, and the pumping record at the present time is over 4,000,000 gallons daily. Regular shipments of from 2 to 3 cars of high-grade silver ore, containing considerable lead and good values in gold, have been made daily to the smelter, while the lower grade ore is blocked out for the mill now under construction. The railroad built to transport the ores from mine to mill is nearly completed and new lines are being run to connect other mines of the group. The mill will be of 125 tons daily capacity, arranged for the concentration and cyanidation of the ores. Its equipment comprises 40 stamps, 8 Wilfley tables, 4 Callow slime cones, and the necessary cyaniding tanks. A shipping product is to be made over the tables, and the sands will be treated in percolation tanks with cyanide solution. Other properties shipping were the Luck Sure, the Old Guard, and the Hershell mines, each operated by independent companies. Near Fairbank the Slimes Tailings Company commenced in October to operate by the cyanide process its lease on the Old Grand Central tailings.

Turquoise district.—This district is located in part of the Dragoon range of mountains, about 50 miles long, running due north and south. Gleeson, Black Diamond, Middlemarch, and Pearce are the principal camps. At Pearce is located the property of the Commonwealth Mining and Milling Company. The property, including the tailings dump, is leased to Swattling & Smith, who are employing 75 men in the mine, mill, and cyanide plant. The mill, equipped with 35 stamps, was operated on ore from the mine, and the cyanide plant is working over old tailings. Silver predominates in the product shipped to the amount of 66 ounces to 1 ounce of gold. The Copper Belle Mining Company ships from Gleeson low-grade copper sulphide ores to the Globe smelters, to be utilized to matte the siliceous oxidized ores. The mine is developed by an incline shaft 335 feet deep. The company owns 2 smelting plants of 35 and 300 tons respective capacity. The Dragoon Mining and Smelting Company began shipping ore to the smelters in October. The mine is developed by an incline shaft 465 feet deep. The ore carries silver, copper, and lead. The Leadville group, operated by the Leadville Mining Company, is developing by a vertical shaft 300 feet deep, and has made a small shipment of ore carrying copper. At Black Diamond camp the Black Diamond Copper Company is ready to renew operations, as the company is said to be free from all litigation. There is a 20-ton copper smelter on the property. Between 20 and 30 men were at work at the close of the year.

GILA COUNTY.

The mining industry of this county is principally confined to the Globe district and camp, which has a population of about 6,500 people and is a terminus of a branch line of the Southern Pacific Railway Company. Its ores are shipped to El Paso, Douglas, and Mexico. In total value of its mineral production, this county ranks fourth in the Territory for the year 1905, and according to reports received from 10 producing properties, the output of crude ore amounted to 241,328 short tons, valued at $4,001,046, or an average value per ton of $16.58, of which the gold and silver contents averaged 42 cents, mainly silver. The total quantity of each metal produced and the value are as follows: Gold, 2,467 ounces, valued at $50,997; silver, 84,982 ounces, valued at $51,329; copper, 24,991,794 pounds, valued at $3,898,720. Comparing these figures with those of 1904, the ore tonnage has increased 141,227 short tons in quantity and $2,157,384 in value. In 1904 the total average value of the ore was $18.42, and in 1905 it was $16.58, a decrease of $1.84. The gold and silver contents of these ores increased from 8 cents to 42 cents per ton. In 1904 and 1905 the producers of copper ores did not report the contents of gold and silver. This product is therefore largely estimated. The total quantity of metals won from the ores shows a decided increase over 1904; in gold, 2,301 ounces, valued at $47,566; silver, 75,311 ounces, valued at $45,793; copper, 10,314,233 pounds, valued at $2,064,025. The Old Dominion Copper Mining and Smelting Company operated its smelters nearly the entire year, with the exception of a period during March and April, when the heavy storms and washouts greatly impeded the work. But for these delays the output would have averaged more than 2,500,000 pounds of blister copper per month. With the addition of a fourth furnace and its converter plant, the capacity of the smelter is between 1,600 and 1,700 tons raw ore daily, while the concentrating mill is calculated to reduce daily 350 tons of ore. The copper product turned out does not come only from the Old Dominion mine, but also from local custom ores, and from concentrates shipped for their sulphur content from properties in Mexico controlled by the same interests. The mine is opened by 3 shafts, the deepest of which is nearly

1,000 feet. All the ores in the district are more or less argentiferous, and as a rule are highly siliceous, requiring heavy iron and lime fluxes in smelting. On the west side of Pinal Creek and north of Bloody Tanks the mines are operated more actively than formerly. The claims receiving most attention are the Live Oak, the Summit, and the Black Warrior. The Live Oak Copper Mining and Smelting Company develops its property by means of a 350-foot vertical shaft and tunnel. The Summit property, operated by Gibson and Henderson, is located 18 miles east of Globe and is being developed rapidly. The main shaft is 340 feet deep. The ore is an enriched sulphide, some of which is so soft and decomposed that pick and shovel do both the work of extraction and development. The United Globe Mines Company supplies its ores to the Old Dominion and Copper Queen smelters. The shaft on the Grey claim of this company is sunk to a depth of 740 feet vertically. A merger may be effected before the end of another year which will put these mines entirely under the control of the Old Dominion Company. The Arizona Commercial Company is developing by a shaft 800 feet deep on the Copper Hill claim, and produced some excellent sulphide ores which go to the local smelter, while the siliceous ore goes to the Douglas plant. Other properties producing copper in the district and county are the Warrior Copper Company, the Eureka Copper Company, and the Sundown mine. In the Hordon district, from a claim named the Producer, operated by P. G. Ellison, some gold and silver bullion was produded from ores by arrastra.

GRAHAM COUNTY.

This county ranks second in the Territory in value of its metal output for 1905. From reports received by the United States Geological Survey its metal production is made up from 9 operators located in 5 mining regions known as Ash Peak, Bunker Hill, Copper Mountain, Greenlee, and Stanley Butte districts. The county list of mines contains 58 names. Nine are producers. These may be classed according to their chief product as 2 silver, 6 copper, and 1 lead mine. The total quantity of crude ore treated or shipped amounted to 952,509 short tons, valued at $8,532,882, or a total average value per ton of $8.96, of which the gold and silver contents averaged 8 cents per ton. The quantity and value of each metal produced are shown in the table following, gold being computed at the coining rate and silver and copper at the year's average prices:

Production of gold, silver, and associated metals in Graham County, Ariz., in 1904 and 1905.

Metal.	1904.		1905.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold..........fine ounces..	2,217	$45,829	2,236	$46,222	+ 19	+ $393
Silver................do....	43,963	25,169	57,191	34,543	+ 13,228	+ 9,374
Copper............pounds..	59,537,295	7,442,162	53,939,212	8,414,517	−5,598,083	+ 972,355
Lead..................do....	....	....	800,000	37,600	+ 800,000	+ 37,600
Total..................	....	7,513,160	....	8,532,882	....	+1,019,722

Production of ores in Graham County, Ariz., in 1905.

	1904.		1905.		Increase.	
	Short tons.	Value per ton.	Short tons.	Value per ton.	Short tons.	Value per ton.
Ore output..............................	946,999	$7.93	952,509	$8.96	5,510	$1.03

The quantity of gold and silver produced in the county in 1904 and 1905, originating in different kinds of ore, is given in the following table:

Source of gold and silver in Graham County, Ariz., 1904 and 1905, by kinds of ore.

[Fine ounces.]

Metal.	Year.	Siliceous ore.	Copper ore.	Copper-lead ore.	Total.
Gold	1904	20	2,197	....	2,217
	1905	3	2,136	97	2,236
Silver	1904	460	43,503	....	43,963
	1905	5,024	47,167	5,000	57,191

Bunker Hill district.—Copper Creek, the main camp of the district, is located 60 miles northwest of Willcox station, which is the nearest supply point on the Southern Pacific Railroad. The Copper Creek Mining Company has been actively developing its property during the year. The ore shipped contains copper, gold, and silver.

Copper Mountain and Greenlee districts.—Copper Mountain and Greenlee districts, with Morenci and Clifton as the main camps, are the most active regions in the county in point of development and production. The Detroit Copper Mining Company at Morenci has doubled the capacity of its existing concentrator. The equipment consists of 80 Frue vanners and 40 Wilfley tables, with a room capacity for about 15 more. The capacity will be about 1,500 tons crude ore every twenty-four hours. The smelter capacity is 600 tons per day. The development will aggregate about 50 miles of underground workings. The mines are opened by two shafts each 250 feet deep and by tunnels from 500 to 4,000 feet long. Production was also recorded from the Home Copper Company and the Cuprite Copper Company, located in the same district.

In the Greenlee district the Arizona Copper Company produced ore during the year, principally from the Longfellow, Metcalf, and Coronado groups of claims, the contents in copper of the first class and of the concentrated ore being about 4 per cent and 9.5 per cent, respectively. The average yield of all the ore was a little less than 2.5 per cent. The first-class ore and concentrates and the copper derived from the leaching works are smelted. In addition to copper the company produces a large quantity of sulphuric acid, which resulted in a yield during the year of about 3,200 tons. The mines continue to develop large ore reserves, the most important being in the Coronado mine, where very high-grade concentrating ore was opened in the 600-foot level. A low-grade ore body 110 feet in width was developed in the 250-foot level in the Humboldt mine. The Clay mine shows a vein 59 feet wide, averaging 4 per cent copper. The new concentrating plant at Morenci will be completed in May next and will have a capacity of 700 tons. The Shannon Copper Company, in its report to stockholders for the year ending August 31, 1905, shows that development work during the year covered 11,931 feet, at an average cost of $3.46 per foot; 2,810 feet were in a vertical direction, and cost $3.27 per foot. Of the whole distance, 3,352 feet were in ore. The total output of ore from the Shannon mine was 188,856 tons; its average content was 4.08 per cent copper. Smelting ore carrying 5.15 per cent copper constituted 53,353 tons, or 28 per cent of the whole. Concentrating ore carrying 3.66 per cent copper, to the amount of 135,503 tons, showed a gain of 48 per cent over its proportion in the preceding year's output. The cost per ton for mining 188,856 tons, was $2.138, the leading item being mining, 93.2 cents; timbering, 50.1 cents; tramway, 11.2 cents; development and exploration, 21.7 cents; filling, 5.6 cents; sampling and assaying, 4.8 cents. The mill was running only two-thirds of the time, owing largely to interruptions in transportation due to heavy floods. The mine product is classified into two grades, the higher being smelted at once, and the lower being concentrated before smelting. The furnace put through a charge of 128,724 tons in the course of the year. It was made up of 52,926 tons of Shannon ore; 3,519 tons of custom ore; 29,735 tons of concentrate; 3,851 tons of fine ore; 12,949 tons of flue dust, and 975 tons of copper slag. The year's output was 11,414,271 pounds fine copper, as against 10,788,891 pounds in the previous year. Of gold 592 ounces, and of silver 17,127 ounces were sold. The average price received for copper was 14.24 cents per pound. The Shannon Company has a smelter of 700 tons daily capacity. A converter plant is under construction, and a blower engine and other equipment were added during the year. For converting matte the company has heretofore depended upon its neighbors. The mill is equipped with jigs and vanners and has a capacity of 500 tons of ore daily. The Standard Copper Company has its property located at Metcalf developed by a vertical shaft 121 feet deep. The other claims are developed by a shaft and tunnel. The ore is shipped to the smelter of the Shannon Copper Company. These shipments of copper ore were usually made in two grades, assaying 13 per cent and 45 per cent of copper, respectively.

Stanley Butte district.—The production of the properties in this district is estimated. The Starlight group of claims, owned by the Tri-Bullion Mining Company, which is largely controlled by Michigan people, was leased to other parties during the year. Some ore carrying gold, silver, and lead has been shipped. Development is carried on by a tunnel 1,200 feet long, with drifts and raises.

MARICOPA COUNTY.

Although Phoenix is the largest city in the county, the town of Wickenburg is located among the most important mining districts. The town is 58 miles from Phoenix and 83 miles from Prescott, on the Santa Fe, Prescott and Phoenix Railway, and is the junction of the Arizona and California Railroad, which when completed will be 120 miles from the Colorado River, the border line of Yuma County, in Arizona, and of San Bernardino County, in California. This railway, now under construction, leaves the main line, on which Wickenburg is located, 4 miles to the north and runs westward through a small portion of Yavapai, thence into Maricopa and Yuma counties, crossing the Colorado River near Parker, to a station known as Bengal—on the main line of the Santa Fe system—in California. At the present time daily trains are being operated over the line between Wickenburg and Salome, a distance of 50 miles. As a result of the transportation facilities already being afforded, mining development has been stimulated not only in the districts adjacent to the operated portion of the line, but also along the route of the final survey. During the latter part of the year some remarkable discoveries were made, the majority of which are located in Yuma County, to be mentioned under that head. The Yavapai County line is in close proximity to Wickenburg, and several producing mines lie just across the line and make this their supply point. The only production recorded in 1905 for Maricopa County was from the treatment of a dump of the Old Vulture mill tailings, a mile north of Wickenburg, and in the form of placer gold produced by transitory miners from operations in San Domingo Wash and the small gulches leading to it and sold to merchants at Wickenburg.

Agua Fria district.—In the Agua Fria district, 20 miles northwest of Phoenix, the Relief Gold Mining Company produced several bars of gold bullion from a siliceous ore by amalgamation. The mill, equipped with Lane rollers, is to have stamps added, and with the new equipment is expected to treat 30 to 40 tons of ore per day. The mine is developed by an incline shaft 500 feet deep.

Cave Creek district.—The Kentucky-Arizona Consolidated secured the property of the Lime Creek Consolidated Gold and Copper Company. The 50-ton smelter of this company was erected near the railroad a few miles out of Phoenix. The intention of the company is to move this plant near Cave Creek.

Vulture district.—The suit against the claim jumpers of the old Vulture mine was won by the new Vulture Mining Company. It is certain this company will renew active development work on the property.

MOHAVE COUNTY.

With recent developments the county has come into prominence through the erection of a lead and copper smelter by the Arizona Smelting Company at Humboldt, near Prescott, in Yavapai County. The mining industry is also stimulated by the promised outlet for its lead ores to the smelting plant being erected by the Arizona and Mexican Mining and Smelting Company, at Needles, Cal., and as a further inducement toward production the railroad rates have been reduced on ores from Kingman and Chloride to Humboldt. The rates are based on the value of the ore, and from Chloride range from $2 per ton on ores valued at $15 per ton to a rate of $5 for ores averaging $100 in value and over. The development work has been active in the numerous mining districts, which, commencing with the most northerly, are Bentley, Gold Basin, Music Mountain, Indian Secret, Minnesota, Weaver, Chimehuevis, Wallapai, San Francisco, and Cedar Valley. Productions were recorded from the first and the last three districts. The greatest values are being produced by the Gold Roads mines, in San Francisco district. Besides the gold, silver, and lead produced in the county, there were several shipments of tungsten made to eastern points.

Through the operations of 21 producers, an increase of 8 reporting over the preceding year, the output of the county amounted to 52,712 short tons of ore, having a total value of $597,525, or an average value per ton of $11.34. The total quantity of gold produced amounted to 26,272 ounces, valued at $543,090; silver, 73,536 ounces, valued at $44,416; copper, 30,399 pounds, valued at $4,742; lead, 112,266 pounds, valued at $5,277. Comparing the figures for 1905 with those for 1904, the ore increased 5,192 short tons, but its total value decreased $16,431. In 1904 the average value of the ore was $12.92, but it decreased in value to $11.34 in 1905, or $1.58 per ton. Its gold and silver value was $12.91 in 1904, which decreased in value to $11.14 in 1905, or $1.77 per ton. The total quantity of gold decreased 1,003 ounces and $20,734 in value; silver decreased 13,246 ounces and $5,267 in value; copper increased 28,919 pounds and $4,557 in value; lead increased 106,230 pounds and $5,013 in value.

Bentley district.—This district is north of the Colorado River, near the Nevada line. The only producer of record for the year is the Grand Gulch Mining Company. During 1905 no regular work was done in the mine. Its workings at the lowest point are 435 feet deep, reached by a double compartment shaft. A new station, cut at the 400-foot level, is in ore. The development on the old Adams claim belonging to the company has been accomplished through a tunnel 3,000 feet in length, with drifts. The waste dump was sorted during the year and the ore hauled by team to Moapa, Nev., and billed to the Salt Lake smelters over the San Pedro, Los Angeles and Salt Lake Railway, which is about 65 miles from the mine. The company formerly made large shipments of ore averaging 45.5 per cent copper and 3 ounces silver per ton to the railroad at Modena, a distance of 145 miles from the mine.

Cedar Valley district.—The Yucca Cyanide Mining and Milling Company, operating the San Francisco mine, has developed the property to a depth of 500 feet and intends sinking deeper. The ore produced is treated in a 10-stamp mill, equipped for amalgamation and concentration.

Gold Basin district.—This region is located 20 miles from the Colorado River, north of the central part of the county. The Cyclopic Gold Mining Company carried on development work in the mine and did some experimental work on the ore by the cyanide process. The Minnesota and Arizona Gold Mining Company, operating the

Eldorado mine, is developed by a shaft 200 feet in depth. The mine is also opened by two tunnels, one 170 feet long and the other 295 feet, connected by 800 feet of drifts and stopes. The ore produced is free milling, and was treated at the company's 10-stamp mill, equipped for amalgamation and cyanidation of the tailings. Other producing claims were the Gold Belt, a free milling ore worked by arrastra and the Never-Got-Left.

Music Mountain district.—The Clay Springs group of claims were worked in a small way during the year, and ore was taken out in doing assessment work.

Owens district.—The Doyle claims, with a shaft down 65 feet, were worked and produced a few tons of siliceous gold ore. This was reduced by arrastra.

San Francisco district.—Mining in this district has been prosecuted during the year with reasonable energy and vigor. At the Gold Roads milling plant the cyanide plant has been enlarged and improved. This may also be said of the German-American mill. The scarcity of water is the greatest drawback in the district, and at the present time is pumped from springs. The location of the mine of the Gold Roads Mining and Exploration Company is in the River Range, 24 miles southwest of Kingman and 25 miles northeast of Needles, Cal., from either of which points on the Santa Fe Railroad it is readily accessible. Its altitude is 2,940 feet. The company owns a number of mining claims following the lode that have a strike of about 15 degrees north of west. The mine is developed by a vertical shaft 600 feet deep, from which numerous laterals extend. These will aggregate about 5,000 feet. The ore is quartz and calc spar, carrying a very finely disseminated gold, which by fine grinding is entirely amenable to the cyanide process. During the year lessees were extracting the richer ore in the upper workings, but the company is now planning to work these higher grade ores itself. Oil engines using Coalinga crude oil as fuel are used in operating the mill machinery as well as the hoist and compressor for the mine. The mill is equipped with 5 Huntington mills, which have a total capacity of 150 tons daily. The ore is ground in cyanide solution, and the slimes are separated from the sand by hydraulic cones, the slimes going to agitating tanks and the sands to 115-ton steel leaching vats through Butter's distributors. The slimes are agitated about four hours by compressed air and discharged to a 20-ton Montejus, which forces the slimes through a pipe into 2 Dehne filter presses, each having a capacity of 4.7 tons. Up to June the Blue Ridge Gold Mines Company operated the Hiltz group of claims, located about 2 miles south of the Gold Roads mine. The shaft is down 200 feet, and drifts run on two levels. In character the ore is similar to that of the Gold Roads. The water flow at 200 feet in depth is said to amount to 50,000 gallons every twenty-four hours. When the 10-stamp mill of this company closed down, the water was leased and piped to the mill of the German-American mine, about 3 miles to the northeast. The German-American Mining Company operates a number of claims near Vivian, the terminus of the narrow-gauge road of the Mohave and Milltown Railway Company, running from the Colorado River opposite Needles, Cal., 15 miles distant. The enlarged milling plant of the company, consisting of 10 stamps and 30-ton cyanide equipment, was completed in September. The mine is developed by two shafts 200 and 210 feet deep. Numerous laterals are run from each shaft. The ore is quartz and calcite, carrying values mainly in gold. Some water is being developed in the Pioneer shaft, 76 feet deep. It is believed that at greater depth sufficient water will be available for use in the mill, thus making a supply from the Blue Ridge mine, 3 miles distant, unnecessary. Crude oil and gasoline are used to operate the mill and hoists. Among the developing mines some new mills are being planned, and one is nearing completion. The Vivian Mining Company has its new plant, a 10-stamp mill, nearly ready for operation. The mine is developed to a depth of 300 feet. The Victor and Virgin property and the Miller-Holmes group, practically controlled by the owners in the Vivian, were actively developed during the year. The Swiss-American Mining Company sunk a shaft 100 feet and expects to continue it 50 feet deeper. Some ore, ready to ship, was taken out in the course of development. The shaft on the Federal Development Company's property has reached a depth of 200 feet, while the drifts will total 300 feet. Other companies operating in the district are the Pasadena Consolidated Mines, the Gold Star, the New Comstock, the Tyro group, and the Rattan mine, worked by the Gold Giant Company. When some arrangement is made for securing a supply of water from the Colorado River, the production of precious metals in the district will undoubtedly increase. With the introduction of inexpensive power many of the mines can be worked that are to-day lying idle.

Wallapai district.—This mining district covers part of the Cerbat Range for 25 miles in length and 10 miles in width. The town of Chloride, and the camps of Mineral Park and Cerbat, Todd's Basin and Stockton, are included within the boundaries and reached from a branch of the Santa Fe Railroad, which starts at Kingman and terminates at Chloride, a distance of 27 miles. The ores are principally lead, carrying good values in gold and silver. The erection of a smelter near Prescott and also at Needles, on the Colorado River, has stimulated production. Another smelting establishment was talked of for Kingman, and even the renewal of operations at one of the furnaces at Chloride is contemplated. The Minnesota-Connor, the Samoan, and the Lucky Boy were the principal producers. These are located near Chloride. Other mines mined ore, but shipments were held back, pending completion of smelters. The Lehigh and Arizona Mining Company operates the Minnesota-Connor mines. This company has taken all the interests of the Philadelphia and Arizona Mining Company. The mine is developed by an incline shaft 600 feet deep. The drifting will aggregate 7,000 feet. The mill is equipped for concentration, and has a capacity of 200 tons of ore per day. Some of the old tailing dump was re-treated in the mill. The Chloride Gold Mining Company operated the Samoan mine, and has made several shipments of lead ore which returned good values in gold and silver. The Lucky Boy claim was also a shipper, with ore values largely in gold and silver. The Vanderbilt mine, situated in Cerbat Canyon, shipped a high-grade gold ore. This mine is one of the first discoveries of the district. Other claims producing were Oro Fino, Spread Eagle group, Virginia Camp, Distaff, Roger Boy, and the Wood Chopper's Relief, in Mineral Park.

PIMA COUNTY.

The construction of the Twin Buttes Railroad from Tucson through the county means the regeneration of many districts in this and Santa Cruz County, bordering on the south. The road may be extended through the Arivaca district, in Pima County, and the Oro Blanco district, in Santa Cruz County. The production of the county for 1905 came from 7 districts, in which 11 properties produced. Nine of these were deep mines and 2 were placers. The total ore output amounted to 37,186 short tons, valued at $964,184, which gives the county fifth rank among the counties of the Territory in value of its metal production. The average total value of the ore in 1905 was $25.93, per ton of which the gold and silver value was 86 cents. The total quantity of gold produced amounted to 829 ounces, valued at $17,137; silver, 49,363 ounces, valued at $29,815; copper, 5,954,770 pounds, valued at $928,944; lead, 50,388 pounds, valued at $2,368. A comparison of these figures with those of the preceding year shows that the ore tonnage increased 35,318 short tons, and the total value of the output, including the placer production, increased $555,758 in value. The total quantity of gold increased 336 ounces and $6,946 in value; silver, 6,311 ounces and $5,168 in value; copper, 2,915,551 pounds and $549,041 in value; while the lead decreased 127,087 pounds and $5,397 in value.

Amole district.—Some ore was shipped from the properties of the Arizona Copper Mining Company. Considerable development is being carried on, and some good ore is being stacked on the dumps. The district is about 10 miles northwest of Tucson. Its ores are low grade but abundant.

Arivaca district.—This district is 65 miles south of Tucson. During the year a few tons of ore were shipped to the El Paso smelter, and some gold and silver bullion was produced from several odd lots of ore produced by chloriders.

Greaterville district.—The Santa Rita Water and Placer Mining Company, owning a large tract of placer lands, operated a hydraulic plant during the winter months and early spring of 1905, and closed down on account of the scarcity of water. The placers in the neighborhood also produced in a small way through the operation of rockers by the Mexicans.

Helvetia district.—This district is located on the eastern slope of the Santa Rita Mountains. Production has been recorded for 1905 as coming from the Lincoln and the Tip Top mines, each producing copper ores. Development and the installation of a smelter in the district will do much to augment the 1906 production. The Helvetia Mines Company and the Little Helvetia Copper Company are both actively developing.

Pima district.—This district, known also as the San Xavier region and Olive camp, is located 18 miles southwest of Tucson. According to county records the district was organized in 1877, and is 10 miles square. The Azurite was the principal property being developed in 1905 by the Mineral Hill Consolidated Copper Company. The shaft is 250 feet deep. A smelter plant with two 30-ton water-jacket furnaces is part of the equipment, and several years ago was in active operation. This company is now planning for a larger reduction plant. Copper is the principal metal product. The Paymaster Mining Company produced some very rich ore. Its incline shaft is 155 feet deep. The ore carries silver, copper, and lead. The Prosperity mine, under bond to the Keystone Development Company, is expecting to ship lead ore in 1906.

Quijotoa district.—Located 70 miles almost directly west of Tucson, the district manages to be on the producers' list year after year. Its placer deposits are worked mostly by dry washing machines. The Imperial placers were operated in this way during the year.

Silver Bell district.—Silver Bell district is located 35 miles northwest of Tucson in the Silver Hill Mountains. The principal properties producing and developing are the Imperial Copper Company, the Cleveland-Arizona Mining Company, the Oxide Copper Company, and the Indiana Development Company. The shipments from the Imperial Copper mine have averaged 100 tons of ore daily. The ore carries copper and silver. The mine is developed by the Mammoth shaft of 3 compartments 500 feet deep, the Union shaft of 2 compartments 350 feet deep, and the Page tunnel, 1,200 feet long. The company will erect a smelter and a concentrating mill. The capacity of the smelter at first is expected to be 300 tons per day. Additional units will be added as the mine develops. The Cleveland-Arizona Copper Company's mine developments are carried on by means of a vertical shaft 245 feet deep and a tunnel 752 feet long. During the period of development irregular shipments of ore have been made to the smelters. The ores contain silver, copper, and lead. The Young America, operated by the Oxide Copper Company, made 2 shipments of ore containing copper while doing assessment work.

Ajo district.—The Growler group, 15 miles from Ajo, was developed by a Boston company. A 600-foot shaft is being sunk on the property. The Rescue Copper Company at Ajo did considerable development work. The McGahan smelter is shipping in machinery, and is expected to be in operation by the middle of the year.

PINAL COUNTY.

The Phœnix and Eastern Railroad is extending its line eastward along the Gila River from Kelvin to Dudleyville, and the increased facilities for transportation have done much to stimulate mining. During the year a smelter was erected at

Christmas (in Gila County) by the Saddle Mountain Mining Company in a district bearing the same name. The operators in this county reporting production for 1905 numbered 11, one of which was a placer property. There is an increase of 5 deep mines over the number reporting the preceding year. The total ore output amounted to 11,965 short tons, valued at $135,645, or an average value per ton of $11.34, of which the gold and silver value was $1.85. The total quantity of gold produced amounted to 694 ounces, valued at $14,346; silver, 13,849 ounces, valued at $8,365; copper, 714,980 pounds, valued at $111,537; lead, 3,500 pounds, valued at $165. A comparison of the figures of 1905 with those of 1904 shows that the ore tonnage increased 11,000 short tons, and, with the placer production, increased $105,676 in total value. In 1904 the average total value of the ore was $31.61 per ton, and in 1905 it was $11.34, a decrease of $20.27 per ton. The gold and silver values fell from $7.20 per ton of ore to $1.85. The explanation for the decrease in value per ton of the 1905 production is that a greater tonnage of lower grade ores was treated in the reduction works at the mines. The total quantity of gold increased 482 ounces and $9,963 in value; silver, 9,367 ounces and $5,799 in value; copper, 528,342 pounds and $88,207 in value; lead, 166 pounds and $19 in value. Among other metals iron increased in value $1,688. Kelvin and Florence, the principal supply points of the county, are located on the Phœnix and Eastern Railroad, a branch of the Santa Fe, Prescott and Phœnix Railway.

Casa Grande district.—About 22 miles south of Casa Grande station, on the Southern Pacific, the Desert Queen Gold Mining Company began operations in August with a steam stamp mill of 25 tons daily capacity. The tailings are classified after amalgamation and the sands cyanided. At present the slimes are impounded until the necessary machinery can be added to treat them. In the early days the mine was an important producer, and has had considerable development work performed on it.

Mineral Creek district.—The Big Lead Mining and Smelting Company, with property located 6 miles from Kelvin, is developing the mine by 2 shafts, each 150 feet deep. The company experimented with a leaching process during the year, and produced about 10 tons of 90 per cent copper precipitates. Another company using the McIntosh leaching process expects to install a plant to treat custom ore.

Old Hat district.—The American Flag group of claims is being developed, and the shaft is at a depth of 160 feet. Some ore carrying gold and silver was produced during the year. The Canada del Oro placers were also operated by rocker and sluices and some gold was secured. The Apache group of claims took out a small quantity of ore which was shipped to the smelter. The Mandina claim was also a producer, and has been developed by an open cut and adit 290 feet.

Pioneer district.—The Golden Eagle claim, owned by the Lake Superior and Arizona Mining Company, is developed by a vertical shaft 300 feet deep. There is also an incline shaft 475 feet deep on the property. The ore, carrying gold, silver, and copper, is shipped to smelters from Florence station, on the Phoenix and Eastern Railroad. The American Copper Company, operating the Coughlan claim, has sunk its shaft 100 feet deep, and shipped some ore carrying copper during the year.

Riverside district.—At Troy Camp, 7½ miles from Kelvin, is the property of the Troy-Manhattan Copper Company. The developments on the mine consist of 2 vertical shafts, 400 and 500 feet deep; an incline shaft, 450 feet; and a tunnel 2,300 feet long, cutting the vein at 800 feet in depth. Fifteen men were employed, and a 40-ton smelter reduces the copper ore, producing a matte, which is shipped to some eastern point. This company has been experimenting with the mineral wulfenite, produced from their ores by concentration. The mineral has been treated and the metal molybdenum produced.

Saddle Mountain district.—About 8 miles southeast of Kelvin the Saddle Mountain group of claims, some of which are located in Gila County, were operated by the Saddle Mountain Mining Company, which produced smelting ore, carrying gold, silver, and copper. The development on the mine consists of 3 shafts, the deepest of which is 330 feet, with about 1,500 feet of working tunnels and 1,500 feet of drifts from shafts. The property is equipped with a Mitchell furnace of 150 tons daily capacity, located at Christmas, in Gila County, and owing to the self-fluxing nature of the ore, the company has found it practicable to treat more than 200 tons of copper ore a day in this furnace. About 200 men are employed.

SANTA CRUZ COUNTY.

The most notable event in the mining industry of the county is the completion of the lead smelter of 100 tons daily capacity, erected by the Mowry Mines Company, in the Patagonia mining district. The first shipment of lead bullion was made during the last month of the year to New York. The smelter was erected for the treatment of ore from the various properties of the Mowry Company, with no apparent intention of treating custom ores. However, the activity of this company has stimulated development of properties in other regions, notably in the Oro Blanco, Washington, and Harshaw camps. There were 3 operators reporting production for the year 1904. The same number reported in 1905. The total ore output amounted to 1,508 short tons, valued at $64,008, or an average value per ton of $42.45, of which the gold and silver contents averaged $30.95. The total quantity of gold produced amounted to 67 ounces, valued at $1,385; silver, 74,990 ounces, valued at $45,294; copper, 9,000 pounds, valued at $1,404; lead, 338,840 pounds, valued at $15,925. Comparing the figures of 1905 production with those of 1904, the ore tonnage is shown to have increased 1,047 short tons in quantity and $55,957 in total value. In 1904 the average total value of the ore was $17.46 per ton, while in 1905 it was $42.45, an increase of $24.99 per ton. The gold and silver values increased from $6.54 to $30.95 per ton. An explanation of the increase in value per ton in 1905 is that the tonnage treated came principally from the richer ores of the Mowry Mines Company, whose tonnage and values will also make a marked increase in the production in the county for 1906. The total quantity of gold produced increased 67 ounces and $1,385 in value; silver, 69,725 ounces and $42,280 in value; copper decreased 18,000 pounds and $1,971 in value, and lead increased 300,985 pounds and $14,268 in value.

Harshaw district.—The World's Fair mine has been producing during the year. The workings of the mine will aggregate about 12,000 feet in development work in shafts and laterals. The deepest workings on the vein are at 500 feet. The ore is shipped to smelters, and carries gold, silver, copper, and lead. East of the World's Fair are the Old Trench, the Hardshell, the Flux, and R. R. R., which have produced a large quantity of high grade lead-silver ore. These properties are developed to depths of from 300 to 500 feet. The old Hermosa mine in this section may also be reworked. Other properties in the vicinity that are under development are: Arizona Gold and Copper Company, Proto mine, Redmen, Alto, Lead Queen, Endless Chain, Soldier Group, Golden Rose, Gladstone Mining Company, Prudential Mining Company, and Blackhawk.

Oro Blanco district.—This district is reached by a tri-weekly stage from Tucson, 75 miles to the north, or from Nogales, 40 miles to the east. With railroad facilities in view, this district has been stimulated in its mining development the past year. The important gold producers of the past have been Old Glory, Oro, Oro Blanco, Tres Amigos, Sorrel Top, Austerlitz, and Yellow Jacket. The Old Glory mine, operated by the American Gold Mining and Milling Company, has a 30-stamp mill, equipped for amalgamating, concentrating, and cyaniding the ores. The Yellow Jacket Mining Company is equipped with a 20-stamp mill, using the amalgamation and cyanide process. The Tres-Amigos Mining Company has a 50-stamp mill, and the Oro Blanco property, operated by the Sierrita Mining and Milling Company, has a 3-stamp mill. The Oro Mining Company has a 10-stamp mill, and the Montana property a 10-stamp concentration plant for treating the lead-silver ores. On a number of the gold quartz locations there can still be seen the old arrastras which were operated years ago by the Mexicans. The only deep-mine producer recorded for the year was the Gold Bullion mine. Some gold was also produced from placer deposits.

Patagonia district.—The Enterprise, Mowry, and other properties, operated by the Mowry Mines Company in this district, have been extensively developed during the last two years. The Mowry mine is a well-known property, which was operated many years ago in a primitive way by Mexicans, and passed into other hands, making interesting history during the civil war. The present company has opened up drifts aggregating several thousand feet. The ores consist of lead and copper sulphides, with associated gold and silver. The first of December, 1905, a lead smelter of 100 tons daily capacity was completed and blown in, producing lead bullion. The Four Metals Mining Company is opening up by tunnel the Phoenix, the Hillside, and the Gross groups of claims (40 claims), situated south and west of of the Mowry mine. Upward of 2,000 feet of work has been done on the properties, in all of which there is said to be an encouraging ore showing. The ores carry copper, lead, gold, and silver values. At Washington camp, several miles to the south of the Mowry mine, is located the Duquesne copper mines, owned by the Westinghouse Company, of Pittsburg. The property comprises 800 acres. It is extensively developed to a depth of 650 feet, and large bodies of ore are opened up. Close by are the mines and reduction works of the Pride of the West Mining Company. The reduction plant has a capacity of 100 tons daily, is equipped for concen tration, and has a 50-ton smelter. This property is temporarily idle, but it is stated that work will be started shortly. Other properties in this section are the Pool, the Belmont, the Redbird, and the Emma.

YAVAPAI COUNTY.

This county holds third place in the aggregate value of its mineral production. Its output for 1905 is reduced mainly because all the mining companies restricted their individual shipments to such ores as would bear shipment from the Territory, and held the lower grade material for shipment to the new smelter at Humboldt, under construction for the Arizona Smelting Company. The completion of this smelting plant will mark the most important event in the mining industry of the county, and has stimulated mining not only in Yavapai County, but to the north, in Mohave County, and to the south in Pinal, Maricopa, and Yuma counties. The ores are delivered by one of the branches of the Santa Fe, Prescott and Phoenix Railway, which has made liberal rates on ores from all points on its line in Arizona. The plant is equipped for copper and lead smelting. In addition to the Arizona smelter 3 reduction plants, utilizing as many different processes, were preparing to operate at Mayer. The Rigby Mining and Reduction Company had about completed the installation of the Pohle-Croasdale metals volatilization process for the reduction of highly siliceous ores. The plant is built to treat 120 tons custom ore per day. The Crown Gold Mining Company, employing the Wood process of dry concentration, installed a 50-ton plant, which is to treat the ores of the George A. Treadwell Mining Company. The latter company has a 250-ton Mitchell economic hot blast smelting furnace for the production of a high grade copper matte. The Congress mine still holds first place among the gold producers, as does the United Verde among the copper producers of the county. The placer mines in the southern part of the county, at Rich Hill, were more productive during the spring of 1905 than at any time for a number of years. The regeneration of this industry is due to the abundance of water in every locality on the surface, or at shallow depths in the gulches, for camp and mining purposes. Productions from the placer mining industry were also reported from along the Hassayampa, Lynx Creek, and Big Bug gulches, and from the smaller gulches leading into them. The gold thus produced is usually traded for supplies or sold to merchants and station keepers in the vicinity of the operations. The Selby smelter and the mint, at San Francisco, receive the greater bulk of the gold produced. The output of placer gold in this county depends very much on the rainfall, and during the last year the unusually heavy rainfall provided abundance of water. From records taken in the vicinity of Congress and at Wickenburg, the rainfall is shown to have amounted to 17.3 inches, which is more than the total for the last three years. The unprecedented wet weather temporarily inflicted hardships on the mining industry by the flooding of mines and the curtailing of operations on account of the difficulties attendant on the hauling of supplies and ores over rail and wagon roads. The county, which has 39 producers, including placers from 6 localities, is credited with an ore production in 1905 of 364,697 short tons, valued at $7,232,398, an average value of $19.83 per ton. This is a decrease of 74,925 short tons in quantity, but an increase in value of $796,294, as compared with the production of 439,622 short tons, valued at $6,436,105, in 1904. Twenty-seven reduction works at mines, including 2 copper smelters, operated in 1905. The number of operated plants compared with 1904 shows that 5 mills have been added to the list and that the operating smelters remain the same. Eighteen milling plants produced concentrates, which were reduced from 100,527 tons of ore, and amounted to 8,952 short tons, containing gold and silver values of $351,881; the gold value amounting to $287,727, or $32.14 per ton; the silver value, $64,154, or $7.16 per ton. The concentrates produced in 1904 amounted to 4,685 short tons, and, as compared with the output of 1905, show the product to have increased 4,267 short tons. Twenty-one mills produced gold and silver bullion. This came from 84,526 tons of ore, which yielded 38,068 ounces, containing gold valued at $511,251; silver, $7,441, a total value of $518,692, or an average value for the gold and silver of $6.13 per ton. The bullion produced in 1904 averaged $9.22 per ton of ore, a decrease of $3.09 per ton, which is accounted for by the diminished operations of several large bullion producers which treated much lower grade ores. The quantity of old tailings treated at 3 plants amounted to 42,793 short tons, valued at $158,128 in gold and silver, or an average value per ton for gold of $3.44; for silver, $0.25. The total quantity of old tailings treated in 1904 was 44,747 short tons, valued at $2.02 per ton in gold and silver. In 1905 there was a decrease in the number of tons of 1,954 and an increase in gold and silver value of $1.67 per ton. The gold and silver product of the county for 1905 is valued at $1,866,241, representing 67,293 ounces of gold, valued at $1,391,070; silver, 786,707 ounces, valued at $475,171. A comparison of these figures with corresponding ones for the preceding year shows that the gold output has decreased 30,122 ounces and $622,677 in value; silver, 166,915 ounces and $70,777 in value. The decrease in these metals is due in a large measure to the decreased operations of several mining companies, and more particularly the reduced tonnage of ore treated by the former great bullion producers. An examination of the tables following shows that the copper and lead output increased, but an inspection of the source of the precious metals shows that the gold and silver declined in all kinds of ore except copper ores, gold in placers, and silver in lead ores.

Production of gold, silver, and associated metals in Yavapai County, Ariz., in 1904 and 1905.

Metal.	1904.		1905.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold..........fine ounces..	97,415	$2,013,747	67,293	$1,391,070	− 30,122	− $622,677
Silver.................do....	953,622	545,948	786,707	475,171	− 166,915	− 70,777
Copper ....pounds..	30,826,286	3,853,286	34,279,734	5,347,638	+3,453,448	+1,494,352
Lead ....do....	497,905	21,783	697,806	32,797	+ 199,901	+ 11,014
Other metals...............	....	1,341	....	12,421	....	+ 11,080
Total.................	....	6,436,105	....	7,259,097	....	+ 822,992

Production of ores in Yavapai County, Ariz., in 1904 and 1905.

	1904.		1905.		Decrease.	Increase per ton.
	Short tons.	Value per ton.	Short tons.	Value per ton.		
					Short tons.	
Ore output	439,622	$14.64	364,697	$19.83	−74,925	+$5.19

The origin of the precious metals by different kinds of ore is given in the following table:

Source of gold and silver in Yavapai County, Ariz., 1904 and 1905, by kinds of ore.

[Fine ounces.]

Metal.	Year.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Copper-lead ore.	Lead-zinc ore.	Total.
Gold	1904	6	57,276	36,279	3,854			97,415
	1905	1,287	21,650	40,884	2,755		717	67,293
Silver	1904		122,252	797,405	33,965			953,622
	1905	156	37,189	707,898	34,780	6,684		786,707

These totals are from ores produced in 17 mining districts, 33 properties contributing. In 1904 the same number of districts produced and 34 properties contributed, a decrease of 1 property for 1905. The principal properties whose product could be credited to the output of 1905 are as follows: Pick and Drill Mining Company, George A. Treadwell Mining Company, Ideal Mining and Development Company, Dividend Gold Mining Company, Jessie Mines Company, Model Gold Mining Company, Poland Mining Company, Oriental Mining Company, Richinbar Mines Company, Yaeger Canyon Copper Company, Oro Grande Mines Company, Neiman Mine, Mt. Union Consolidated Mining Company, Cash Mines Company, Climax Mining Company, Reliance Gold Mining Company, Congress Consolidated Mines Company, Golden Bell, Lincoln Gold Mining Company, Great Peck Mining Company, Theising group, Derby, Crown King Mines Company, Tiger Gold Company, United Verde Copper Company, Equator Mining and Smelting Company, Metals Milling Company, Rincon Mines Company, Octave Mining Company, Monica Mine, Picacho Blanco Mining Company.

Agua Fria district.—The Pick and Drill Mining Company has developed its property by a tunnel and shaft. The shaft is 800 feet deep, and a good deal of milling ore has been taken out. A 6-stamp mill was erected during the year and operated a short time.

Big Bug district.—The Dividend Gold Mining Company, equipped with a 10-stamp mill, operated mine and mill until August, 1905. The George A. Treadwell Mining Company operated the Hackberry and Iron Queen mines. The former is developed by a shaft 500 feet deep, the latter by a shaft 400 feet deep. The company owns a 250-ton copper smelter at Mayer. The Ideal Mining and Development Company, operating the Gladstone mine, was a steady producer during 1905, shipping its product by wagon 2½ miles from McCabe to the railroad, thence to the Arizona Smelting Company, at Humboldt. The Gladstone mine is developed by an incline shaft, which is 900 feet deep. The Ideal Company purchased on December 22, 1904, the McCabe and the Model mines, adjoining properties, at receiver's sale. The McCabe produced during January and February. It is developed by a vertical shaft 713 feet deep and is equipped with a mill of 80 tons capacity, containing 10 stamps and one 40-ton Elspass mill, plates, and 4 concentration tables. The Jessie Mines

Company put in a number of improvements upon its property and is developing the mine by means of a 170-foot shaft. Development work and production was resumed by the Poland Mining Company from the Poland and Accidental veins, developed by means of a crosscut tunnel about 8,000 feet long, which passes through the mountain to the headwaters of Lynx Creek. This tunnel intersects the veins at a depth of from 250 to 600 feet below the surface. The mill is located at the portal of the tunnel on Big Creek. It was put in operation October 8, 1905, the equipment, with plate and concentrators, treating about 75 tons of ore per day. Ninety men are employed by the company. The Lelan mine at Chaparal is developed by a vertical shaft 500 feet deep. The drifts, tunnels, and winzes will aggregate 2,000 feet. A 10-stamp amalgamation and concentration mill is located on the property and was operated during the year. The Oriental Mining Company, operating the Postmaster and Lottie mines, produced from the Postmaster milling ore which was treated in a mill of 50-ton capacity fitted up for concentration work. The main shaft is sunk to a depth of 425 feet. At several points along Big Bug Creek the placer deposits were worked in a small way by transitory miners and the gold product was sold or traded to storekeepers.

Black Canyon district.—In October the 50-ton cyanide plant of the Richinbar Mines Company was completed. The mill equipment consists of 10 stamp plates and concentrators. The mine is developed by a 500-foot vertical shaft.

Black Hills district.—The Yaeger Canyon Copper Company, operating the Queen Bee mine, is developed to 800 feet in depth by an incline shaft. The concentration plant is of 50 tons capacity. The ore treated contains copper and silver.

Black Rock district.—The Oro Grande Mines Company operates the Oro Grande and Frenchman claims. Several shafts have been sunk on the property, the deepest being 340 feet. Drifts and crosscuts will aggregate 6,000 feet. The ore produced was taken out in course of development. The mill of 10 stamps, equipped for amalgamation, is of 50 tons capacity.

Hassayampa district.—The Mount Union mine, operated by the Mount Union Consolidated Mining Company, is equipped with Huntington mills and concentrators. The concentrated product is shipped to the Arizona Smelting Company. The mine is developed through an incline shaft 525 feet deep. The ore carries gold, silver, and lead. The Cash Mines Company operated about two months. The mine is developed by a 400-foot shaft. The ores carry gold, silver, copper, and lead. A 10-stamp mill equipped for amalgamation and concentration is connected with the property. The Climax Mining Company operated its 10-stamp mill, equipped for amalgamation and concentration, for a short time. The mine is developed by tunnels. The Reliance Gold Mining Company, operating the Sundance claims, has one shaft 350 feet deep, with several laterals. The mill, equipped for amalgamation and concentration, is of 50 tons daily capacity.

Martinez district.—This section remains the largest producer of bullion in Yavapai County. The prominence of this district is chiefly due to the Congress Consolidated Mines Company. This property is developed by incline shafts deeper than those of any other mine in the Territory. There are 115 men at work in the mine and mill. A large quantity of milling ore is piled on the dump ready for the mill, which is equipped with 80 stamps and concentrating tables. The cyanide plant, equipped to roast the ore, is of 200 tons daily capacity.

Peck district.—The principal mine developing in this district belongs to the De Soto Mining Company, formerly the Bradshaw Mountain mine. Its Hot Number tunnel is the principal opening and is run about 2,500 feet under the mountain. There is a total of over 15,000 feet of development work on the group. Its main ore body is 85 feet wide and assays $2 gold, $1.50 silver, and 3.54 per cent copper. The ore produced during the year was shipped to the Arizona Smelting Company, at Humboldt, awaiting the completion of the smelter. The equipment consists of a hoisting plant, compressor plant with drills, and an ariel tramway 4,000 feet in length, connecting the tunnel with the Bradshaw Mountain Railway at Middleton. The Theising and Golden Bell group of claims were operated, and the ore was treated in a stamp mill with concentrators. The ores contained gold, silver, and lead. The Great Peck Mining Company operated the mine through lessees. Some silver ore was produced. The company will operate the property on its own account hereafter. The Lincoln Gold Mining Company is getting out 30 tons of milling ore daily. The company is installing a larger hoisting plant, and the 10-stamp mill, equipped for amalgamation and concentration, may be increased to 25 stamps during next year.

Thumb Butte district.—Some experimental work was carried on at the Derby mine, which has a 5-stamp mill, equipped to treat the ores by amalgamation and concentration.

Tiger district.—The Crown King Mines Company leased the old tailing dump, which produced a good grade of concentrates, that were shipped to the smelters at Humboldt and Pueblo. The mine was not operated, owing to litigation. The Tiger Mining Company is located at Harrington, about 3 miles distant from Crown King, the present terminus of the Bradshaw Mountain Railroad. The chief development has been done through tunnels, of which 10 in all have been run, aggregating 7,335 feet. For deeper development a 3-compartment shaft has been started near the portal of tunnel No. 8, and will be sunk 350 feet, to connect with the workings north of No. 11 tunnel. The property is equipped with a mill of 20 stamps, 2 Wilfley and 4 Standard concentrators. The ore and concentrates shipped during the year contained gold, silver, and copper.

Verde district.—Jerome is the main camp of the district, 26 miles from Jerome Junction, on the Santa Fe, Prescott and Phoenix Railway, connected by the United Verde and Pacific Railway, owned by the United Verde Copper Company. Some activity has been displayed during the year in opening up the mines of this district. Several properties are being put in a condition of active work after a number of years of idleness. The only producers at the present time are the United Verde and the Equator, each of which properties have smelters. The United Verde property has been in operation twenty-three years. The mine is developed by a shaft 900 feet deep and laterals, comprising many miles of underground workings. The smelter is equipped with 3 furnaces, and preparations at the close of the year were being made to start an additional furnace of 300 tons capacity. Heavy rains in the spring months caused considerable damage by water reaching a part of the mine that has been burning steadily for the last six years. An explosion resulted, killing several miners. Besides, the ground around the old workings caved in and the surface subsided several feet. The Equator Mining and Smelting Company, operating the Iron King mine, closed down in July. At the Cleopatra mine, operated by the Cleopatra Copper Company, the lumber and timber for the smelter was on the ground at the close of the year and grading on the 100-ton smelter site has been completed.

Walker district.—This district is located 14 miles south of Prescott. The Metals Milling Company has taken over the old Sheldon mine, 14 miles south of Prescott. The property is developed to a depth of 220 feet by upward of 3,000 feet of shafts and laterals, whereby a large tonnage of $15 copper-gold ore is blocked out. The ore is a heavy iron oxide that concentrates to a 2 and 3 to 1 product. The equipment comprises a 50-ton concentration mill. The product of the mine and mill will be transported through the Poland tunnel to the Poland station, on the branch railroad to Humboldt. The placers in the vicinity of Walker, on Lynch Creek, were worked by transitory miners, and the production was recorded by storekeepers, who buy the gold dust.

Weaver district.—The Rincon Mines Company, operating the Welcome mine, 10 miles east of Congress Junction, has its shaft sunk to a depth of 1,050 feet. A concentration plant, equipped with one Elspass mill and concentrators, was in operation part of the year. The Octave Mining Company closed its plant down in the spring of 1905, but resumed operations during the last month of the year. The mine is being extensively developed. In the past the property has produced a large quantity of gold bullion. The Monica mine has altogether 2,000 feet of development work and is operated by an incline shaft 291 feet deep. The year's production came from ore shipped to Kirkland, 17 miles from the mine, and treated by amalgamation in a stamp mill. The Rich Hill, in the district, has yielded from the surface fabulous sums in the past. It was the scene of much activity during the spring months of the year. A total amount of $16,273 in gold dust extracted from the gravels on Rich Hill and vicinity was sold to storekeepers in the neighboring camps.

YUMA COUNTY.

The mining interests of this county have been active on account of improvements in transportation facilities made during 1905 in the building of the Arizona and California Railway (p. 37), which will cross the Colorado River at Parker. The Southern Pacific Railroad, as is well known, crosses the southern part of the county.

The Plomosa district is the most promising of any of the sections of the desert country south of Bill Williams River. In the Bill Williams section a number of undeveloped properties will be relieved of the more or less prohibitive transportation expense under which they have labored before the advent of the railroad. This county in 1905 suffered a decrease in tonnage for all metals produced, except lead. Reports of production were received from 7 properties, one of which was a placer mine. The number reporting is the same as in 1904. The total ore output in 1905 was 62,649 short tons, with a total value of $305,754, or an average value per ton of $4.88, of which the gold and silver contents averaged $4.68, mainly gold. The total quantity of gold produced amounted to 13,894 ounces, valued at $287,215; silver, 11,733 ounces, valued at $7,087; copper, 350 pounds, valued at $55; lead, 260,130 pounds, valued at $12,226. In comparison with the figures for 1904, the ore tonnage is seen to have decreased 6,513 short tons in quantity and $156,339 in total value. In 1904 the total average value of the ore was $6.69 and in 1905 it was $4.88, a decrease of $1.81. The gold and silver contents of these ores decreased from $6.53 to $4.68 per ton. The decrease was caused mainly by the loss of certain mines which operated in 1904 and did not resume in 1905. The total quantity of gold decreased 7,564 ounces and $156,361 in value; silver, 2,124 ounces and $846 in value; copper, 850 pounds and $95 in value; lead increased 2,680 pounds and $963 in value.

Castle Dome district.—This mineral region is located about 20 miles north of Yuma and 16 miles east of the Colorado River. Since 1869 the mines have been worked almost continuously. The La Colorado and also the claims belonging to the Castle Dome Mining and Milling Company produced during the year lead ore carrying silver.

Ellsworth district.—Eight miles to the southwest of Wendendale, on the New Arizona and California Railroad, is located the property of the Socorro Gold Mining Company, owning and operating a 20-stamp mill, equipped with plates for amalgamation, and 3 Standard and 2 Frue vanner concentrators. The concentrates, after grinding 8½ hours to 100 mesh, are cyanided raw, in a 5-foot amalgamation pan. The extraction has been as high as 90.4 per cent of the total values. The mine is developed by an incline shaft 657 feet deep, with drifts aggregating 2,300 feet. These properties are able to furnish from their present development a considerable tonnage of ore, carrying gold and silver. The emerald group of claims is situated in Cunningham Pass. A small shipment containing gold and copper was made. There are various other properties of copper, gold, and silver in this district that are developed sufficiently to produce, and will be heard from in 1906.

Kofa district.—This district is situated 75 miles northeast of Yuma. The principal producing mine is the property of the King of Arizona Mining Company. The mine is developed by a vertical shaft 500 feet deep and tunnels 2,000 feet. A mill using the cyanide process is equipped with Cornish rolls in which the ore is dry crushed. The capacity of the plant is about 175 tons of ore per day. The ore carries gold and silver.

Plomosa district.—This section appears to be the most promising of any of the sections. There are a large number of mining properties carrying gold, silver, and copper, surrounding the town of Quartzsite, located in the valley to the west of the Plomosa range and east of the River range of mountains. Some of the mines in the 2 ranges just mentioned are the Guadalupe, Arizona Copper Company's mines, and various small prospects on the west of the Plomosa range; and the Desert Queen, a promising high grade property. The Valenzuella Copper Company has commenced the construction of a small smelter upon its properties in the River range. In addition to these are numerous properties which have been held back on account of lack of cheap transportation, and among this great number of prospects some good mines will probably be found.

There are copper and gold properties in the immediate vicinity of the Colorado River, from 4 to 10 miles above Parker, and very large and promising copper deposits on the opposite side of the river or California side, within a few miles of the proposed line of the Arizona and California Railway; among them the American Eagle group of copper properties. Several placer properties were operated and gold dust worth $18 per ounce was produced.

CALIFORNIA.

By Charles G. Yale.

PRODUCTION.

For the calendar year 1905 the returns received from mining companies and individual producers show that the State of California made an output of gold, silver, copper, lead, and platinum to the value of $22,177,733, which is somewhat over a million dollars less than in the previous year. The falling off was in the silver and copper, and mainly in the latter metal.

The gold output for the year was $18,898,545, the silver $650,009, copper $2,604,816, lead $21,043, and platinum $3,320. Comparing these figures with the corresponding ones of the previous year, it is seen that the gold yield increased by $264,869, the lead $16,873, and the platinum $1,454. The silver yield was $193,927 less, and the copper values fell off $1,181,206. The following table shows these figures in detail as to both quantities and values:

Production of gold, silver, and associated metals in California in 1904 and 1905.

	1904.		1905.		Increase (+), decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold......fine ounces..	901,484	$18,633,676	914,217.14	$18,898,545	+ 12,733.14	+ $264,869
Silver ....do....	1,480,589	843,936	1,076,174	650,009	− 404,415	− 193,927
Copper ....pounds..	29,961,590	3,786,022	16,697,544	2,604,816	−13,264,046	−1,181,206
Lead ....do....	124,200	4,070	447,723	21,043	+ 323,523	+ 16,973
Platinum.crude ounces	117	1,866	200	3,320	+ 83	+ 1,454
Total............	....	23,269,570	....	22,177,733	....	−1,091,837

There were 1,139 mines in California which reported a product in 1905, of which 658 were placers and 481 were deep mines. Returns were also received from 2007 non-producing mines, without counting the many idle ones from which no returns were received.

Of the 481 deep mines 449 were gold producers, 9 silver, 20 copper, and 3 lead. Of course some of the gold mines also yielded certain proportions of silver and copper. The quantity of ore produced by these deep mines was 2,696,603 short tons, which is 85,835 tons less than in 1904, though there were 481 deep mines producing in 1905 as against 474 in 1904. The total average value per ton in 1905 was $6.03 as compared with $6.57 in 1904, and the average value per ton in gold and silver was $5.06 as compared with $5.21 in 1904. Aside from Alpine, Modoc, and Monterey counties, in which only sample lots of high grade ores were worked, the highest average value per ton was in Sierra and Fresno counties, the former working 18,378 tons of ore valued at $21.21 per ton, and the latter 12,525 tons valued at $21.41 per ton. The highest value per ton in gold and silver, aside from the three counties named with sample lots, was in Sierra County—$21.21. More ore was crushed in Amador County than elsewhere—649,693 tons from 25 producing mines, with a total yield of 123,622 more than in 1904. The total average value per ton was $3.67 in this county, and the same average is noted for value in gold and silver.

The lowest averages per ton in gold and silver were, generally speaking, from the mother lode counties of Amador, Calaveras, El Dorado, Mariposa, and Tuolumne. Mines in these counties crushed ore which aggregated 1,626,320 tons. The Amador County average per ton was $3.67, Calaveras $2.81, El Dorado $6.98, Mariposa $4.93, and Tuolumne $4.27.

There were 29 counties in the State reporting more or less product from deep mines, the total number of short tons crushed in 1905 having been 2,696,603. Of this the mother lode mines in the five counties named yielded by far the largest proportion—1,626,320 tons, leaving 1,070,283 tons divided among the other 24 counties in which deep mines are worked.

The following table shows, by counties, the production of the metals in the State in 1905:

Production of gold, silver, copper, lead, and platinum in California in 1905, by counties.

County.	Gold.		Silver.	
	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*	
Alpine	17.41	$360	2	$1
Amador	117,075.28	2,420,161	21,420	12,938
Butte	125,334.10	2,590,886	10,907	6,588
Calaveras	86,130.98	1,780,485	105,693	63,838
Del Norte	326.97	6,759	60	36
El Dorado	18,653.19	385,596	3,253	1,965
Fresno	1,715.42	35,461	14,930	9,018
Humboldt	2,429.58	50,224	346	209
Inyo	4,426.36	91,501	84,622	51,112
Kern	54,246.27	1,121,370	170,469	102,963
Lassen and Los Angeles	7,497.34	154,984	3,503	2,116
Madera	3,140.70	64,924	2,048	1,237
Mariposa	20,964.26	433,370	6,763	4,085
Mendocino	1.98	41		
Modoc	1.26	26		
Monterey	66.42	1,373	7	4
Mono	15,090.96	311,958	15,876	9,589
Nevada	148,849.75	3,076,997	41,129	24,842
Placer	25,795.22	533,235	29,177	17,623
Plumas	13,060.85	269,992	1,847	1,116
Riverside	287.20	5,937	91	55
San Bernardino	21,017.08	434,461	66,969	40,449
Santa Barbara	33.86	700	3	2

Production of gold, silver, copper, lead, and platinum in California in 1905, etc.—Con.

County.	Gold.		Silver.	
	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*	
San Diego	4,267.25	$88,212	10,078	$6,087
Sacramento	31,473.96	650,624	2,745	1,658
Shasta	34,188.47	706,738	270,530	163,400
Sierra	24,737.70	511,373	13,101	7,913
Siskiyou	36,885.28	762,486	7,318	4,420
Stanislaus	2,418.75	50,000	828	500
Trinity	37,540.71	776,035	5,977	3,610
Tulare	191.66	3,962	598	361
Tuolumne	62,833.70	1,298,888	19,076	11,522
Yuba	13,517.22	279,426	1,245	752
Undistributed			165,563	100,000
Total	914,217.14	18,898,545	1,076,174	650,009

County.	Copper.		Lead.		Platinum.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Ounces.*		
Alpine							$361
Amador	10,000	$1,560					2,434,659
Butte					110.0	$1,770	2,599,244
Calaveras	3,666,810	572,022					2,416,345
Del Norte					1.5	22	6,817
El Dorado	160,000	24,960					412,521
Fresno	1,440,000	224,640					269,119
Humboldt					12.5	204	50,637
Inyo	151,606	23,651	447,723	$21,043			187,307
Kern							1,224,333
Lassen and Los Angeles							157,100
Madera							66,161
Mariposa	12,541	1,956			1.5	25	439,436
Mendocino							41
Modoc							26
Monterey							1,377
Mono							321,547
Nevada					1.2	20	3,101,859
Placer	367,250	57,291				36	608,185
Plumas	1,066	166					271,274
Riverside							5,992
San Bernardino	52,603	8,206					483,116
Santa Barbara							702
San Diego	4,803	749					95,048
Sacramento					40.0	700	652,982
Shasta	10,830,865	1,689,615					2,559,753
Sierra							519,286
Siskiyou					5.3	93	766,999
Stanislaus							50,500
Trinity					26.0	450	780,095
Tulare							4,323
Tuolumne							1,310,410
Yuba							280,178
Undistributed silver							100,000
Total	16,697,544	2,604,816	447,723	21,043	200	3,320	22,177,733

The counties which increased their gold output in 1905 over previous year were Amador, Butte, El Dorado, Fresno, Lassen and Los Angeles, Mariposa, Mendocino, Modoc, Mono, Nevada, Plumas, Santa Barbara, Sacramento, Sierra, Trinity, Tulare and Yuba. The greatest increase was shown in Butte County, which is due to the operation of a large number of gold dredges. Other large increases are in Amador, Nevada, Sacramento, Sierra, Trinity, and Yuba. All the counties show increased silver output except six. In copper material increases in output were shown in Calaveras and Fresno counties. The main loss in this metal is in Shasta County, where the falling off in value amounts to $1,713,903 for the year, owing to the closing down of certain prominent works. The increase in lead comes from Inyo County. Most of the increase in platinum comes from the gold-dredging counties of Butte and Sacramento. The details of these increases and decreases are shown in the following table:

Increase (+) or decrease (−) in production of metals in California in 1905 as compared with 1904, by counties.

County.	Gold.	Silver.		Copper.		Lead.		Platinum.	
	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
		Fine ounces.		*Pounds.*		*Pounds.*		*Crude ozs.*	
Alpine	− $4,467	− 253	− $144						
Amador	+339,360	+ 9,885	+ 6,363	− 4,000	+ $160				
Butte	+644,301	+ 6,967	+ 4,342					+ 43.0	+ $725
Calaveras	− 6,551	− 16,271	− 5,681	+ 1,055,150	+ 294,857				
Del Norte	− 558	+ 60	+ 36						+ 2
El Dorado	+ 8,887	+ 3,225	+ 1,949	+ 160,000	+ 24,960				
Fresno	+ 27,749	+ 14,923	+ 9,014	+ 1,440,000	+ 224,640				
Humboldt	− 10,927	+ 346	+ 209					+ 3.0	+ 54
Inyo	− 44,287	+ 16,433	+ 12,244	+ 143,198	+ 22,801	+323,523	+$16,973		
Kern	−263,371	−106,057	− 54,657						
Lassen and Los Angeles	+ 26,590	+ 719	+ 529						
Madera	− 10,279	+ 2,004	+ 1,212	− 10,300	− 1,300				
Mariposa	+ 5,317	+ 1,849	+ 1,284	+ 3,041	+ 816			+1.5	+ 25
Mendocino	+ 4								
Modoc	+ 26								
Monterey	− 6,295	+ 7	+ 4						
Mono	+ 45,672	− 2,247	− 741						
Nevada	+145,883	+ 19,469	+ 12,496					+ 1.2	+ 20
Placer	−257,106	+ 8,046	+ 5,578	− 232,750	− 14,709			− 20.2	− 329
Plumas	+ 11,265	+ 1,034	+ 652	+ 1,066	+ 166				
Riverside	− 1,482	− 37	− 18						
San Bernardino	−163,263	+ 43,160	+ 26,878	− 101,874	− 6,814				
Santa Barbara	+ 700	+ 3	+ 2						
San Diego	−244,473	+ 9,706	+ 5,875	+ 4,803	+ 749				
San Luis Obispo	− 630								
Sacramento	+239,906	+ 2,745	+ 1,658					+ 40.0	+ 700
Shasta	−325,429	−430,674	−236,286	−15,607,280	−1,712,902				
Sierra	+131,251	+ 10,387	+ 6,366						
Siskiyou	− 40,110	+ 5,311	+ 3,276					+ 4.5	+ 77
Stanislaus		+ 363	+ 235	− 7,300	− 930				
Trinity	+236,922	+ 5,716	+ 3,461					+ 10.0	+ 180
Tulare	+ 2,862	+ 598	+ 361						
Tuolumne	−357,658	− 3,150	− 1,147						
Ventura	− 3,700								
Yuba	+138,760	+ 1,194	+ 723						
Unapportioned		− 9,876		− 107,800	− 13,700				
Total	+264,869	−404,415	−198,927	−13,264,046	−1,181,206	+323,523	+ 16,973	+ 83.0	+1,454

The number of deep producing mines has not increased as much as anticipated there being but few more than in 1904. The tonnage output was less, as was the total average value per ton, and the average value per ton in gold and silver. This is shown in the following table:

Tonnage of ores sold or treated, number of producing mines, and tenor of ores in 1904 and 1905.

County.	Total tons of ore sold or treated.		Number of deep mines producing.		Average total value per ton.		Average value per ton in gold and silver.	
	1905.	Increase (+) or decrease (−) compared with 1904.	1904.	1905.	1904.	1905.	1904.	1905.
	Short tons.	*Short tons.*						
Alpine	1	− 899	1	1	$5.52	$361.00	$5.52	$361.00
Amador	649,693	+123,622	23	25	3.92	3.67	3.92	3.67
Butte	1,058	− 10,108	8	10	3.44	10.15	3.44	10.15
Calaveras	547,972	− 87,605	32	32	3.10	3.86	2.64	2.81
Eldorado	36,708	− 19,395	31	29	5.09	7.66	5.09	6.98
Fresno	12,525	+ 12,500	5	4	184.00	21.42	184.00	3.48
Humboldt	....	− 29	1	0	3.21	....	3.21	....
Inyo	8,907	− 1,191	27	22	17.88	20.73	17.43	15.71
Kern	252,776	+ 35,123	44	45	7.53	4.84	7.53	4.84
Lassen and Los Angeles	27,103	+ 7,932	2	4	6.78	5.79	6.78	5.79
Madera	5,380	− 1,869	8	8	10.48	12.30	10.36	12.30
Mariposa	88,316	− 3,873	19	23	4.65	4.95	4.64	4.93
Modoc	1	+ 1	....	1	....	26.00	....	26.00
Monterey	2	− 23	1	1	20.00	62.50	20.00	62.50
Mono	23,444	+ 1,060	12	11	12.36	13.70	12.36	13.70
Nevada	325,266	+ 67,246	41	43	10.20	8.46	10.20	8.46
Placer	23,939	− 27,144	21	19	5.54	8.59	4.17	6.20
Plumas	31,455	+ 1,625	18	17	5.42	5.69	5.42	5.69
Riverside	753	+ 332	5	3	19.71	7.96	19.71	7.96
San Bernardino	34,039	− 489	13	13	17.94	13.89	17.51	13.65
San Diego	9,650	− 38,036	11	6	6.83	9.33	6.83	9.25
Shasta	214,036	− 90,964	35	26	15.77	11.89	4.62	4.00
Sierra	18,378	− 12,009	10	11	5.25	21.21	5.25	21.21
Siskiyou	31,846	+ 5,140	34	48	13.09	11.13	13.09	11.13
Stanislaus	6,840	− 7,160	1	1	5.02	7.38	5.02	7.38
Trinity	40,468	+ 15,140	27	30	7.51	8.75	7.51	8.75
Tulare	500	+ 490	1	3	110.00	8.65	110.00	8.65
Tuolumne	303,631	− 56,783	38	39	4.51	4.27	4.51	4.27
Ventura	....	− 120	1	0	17.50	....	17.50	....
Yuba	1,916	+ 1,651	4	6	19.64	9.31	19.64	9.31
Total	2,696,603	− 85,835	474	481	6.57	6.03	5.21	5.06

The records show the treatment of 28,419 tons of concentrates valued at $1,783,976. The largest quantity was from Amador County, valued at $782,973. It was this county which also produced the most ore. Calaveras comes next in order, followed by Nevada and Tuolumne. There were more old tailings worked in San Diego than in the other counties. The next in rank being Calaveras, followed by Mono. These facts are shown in detail in the following table:

Tonnage and value of ore, concentrates, and old tailings in California in 1905.

[Short tons.]

County.	Total ore.		Concentrates produced.		Old tailings worked.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alpine	1	$361				
Amador	649,693	2,384,613	10,033	$782,973		
Butte	1,058	10,743				
Calaveras	547,972	2,113,473	8,275	353,905	2,542	$17,240
Eldorado	36,708	281,182	979	28,988		
Fresno	12,525	268,262				
Inyo	8,907	184,599				
Kern	252,776	1,224,247				
Lassen and Los Angeles	27,103	157,025				
Madera	5,380	66,161				
Mariposa	88,316	436,958	735	41,852		
Modoc	1	26				
Monterey	2	125				
Mono	23,444	321,247			1,120	8,234
Nevada	325,266	2,750,277	5,537	309,850		
Placer	23,939	205,727	139	5,534		
Plumas	31,455	179,094	286	6,677		
Riverside	753	5,992				
San Bernardino	34,039	472,697				
San Diego	9,650	90,028			6,400	53,612
Shasta	214,036	2,545,085				
Sierra	18,378	389,855			500	2,030
Siskiyou	31,846	354,306	10	402		
Stanislaus	6,840	50,500				
Trinity	40,468	354,096				
Tulare	500	4,323	3	462		
Tuolumne	303 631	1,296,966	2,422	253,333		
Yuba	1,916	17,839			100	602
Undistributed		100,000				
Total	2,696,603	16,265.807	28,419	1,783,976	10,662	81,718

In making this inquiry in the State of California reports were received from 3,146 mining properties, of which 1,139 were producers and 2,007 were nonproductive. There were 481 deep mines producing, of which 449 produced gold, 9 silver alone, 20 copper, and 3 lead. Of gold placer companies 658 reported production, 227 of them being hydraulic, 26 dredging, 119 drift, and 286 surface placers worked by sluices, etc. Of the 26 dredging companies reporting some had two, some three or more dredging machines. More producing mines—178—are being worked in Siskiyou than in any other county of the State, and it has also the largest number of placers and quartz properties producing. It also has the largest number of hydraulic mines yielding gold and, with the exception of Butte County, which reported one more, the largest number of surface placers.

Of deep gold mines the largest number is in Siskiyou County, but the largest producers are in Nevada, and the greatest tonnage of ore comes from Amador, Calaveras, Kern, Nevada, Shasta, and Tuolumne.

Number of mines in California classified by chief products in 1905, by counties.

County.	Nonproducing mines.	Gold placer mines.					Deep mines.					Total mines reporting product.
		Hydraulic.	Dredging.	Drift.	Surface.	Total.	Gold.	Silver.	Copper.	Lead.	Total.	
Alpine	4						1				1	1
Amador	104	2		1	8	11	24		1		25	36
Butte	112	5	15	13	39	72	10				10	82
Calaveras	117	3	2	9	10	24	30		2		32	56
Del Norte	6	4			5	9						9
Eldorado	144	4	1	11	13	29	28		1		29	58
Fresno	27				2	2	3		1		4	6
Humboldt	10	15			9	24						24
Inyo	70				2	2	10	4	5	3	22	24
Kern	107				1	1	43	2			45	46
Lassen and Los Angeles	17				1	1	4				4	5
Madera	39						8				8	8
Mariposa	71			2	2	4	22		1		23	27
Mendocino	1				1	1						1
Modoc	2						1				1	1
Monterey	5				1	1	1				1	2
Mono	27	1			1	2	11				11	13
Nevada	102	6		7	9	22	43				43	65
Orange	6											
Placer	120	13		22	26	61	18		1		19	80
Plumas	144	13		11	47	71	16		1		17	88
Riverside	25						3				3	3
San Bernardino	52				2	2	8	3	2		13	15
Santa Barbara					1	1						1
San Diego	50				1	1	5		1		6	7
San Luis Obispo	1											
Sacramento	11		4	2	2	8						8
Shasta	160	1		1	10	12	22		4		26	38
Sierra	78	15		29	10	54	11				11	65
Siskiyou	145	83	2	7	38	130	48				48	178
Stanislaus							1				1	1
Trinity	90	56	1	1	17	75	30				30	105
Tulare	12						3				3	3
Tuolumne	110	1		1	2	4	39				39	43
Ventura	7											
Yuba	31	5	1	2	26	34	6				6	40
Total	2,007	227	26	119	286	658	449	9	20	3	481	1,139

As to source of gold production with reference to classification of ores in the following table the placers of various kinds—hydraulic, dredge, drift, and surface—are grouped together, and under the head of deep mines are given the results from siliceous ores, copper ores, and lead ores. The placers show an increase of gold output. The yield from siliceous and copper ores shows a falling off, while the lead ores evince some increase. The main increase in the grand total is, however, due to the placers.

Source of gold product in California by kinds of ore in 1905, by counties.

[Fine ounces.]

County.	Placers.	Deep mines.				Grand total.
		Siliceous ores.	Copper ores.	Lead ores.	Total.	
Alpine		17.41			17.41	17.41
Amador	2,408.15	114,667.13			114,667.13	117,075.28
Butte	124,821.86	512.24			512.24	125,334.10
Calaveras	14,609.34	68,768.38	2,753.26		71,521.64	86,130.98
Del Norte	326.97					326.97
Eldorado	6,333.25	12,319.94			12,319.94	18,653.19
Fresno	41.26	262.31	1,411.85		1,674.16	1,715.42
Humboldt	2,429.58					2,429.58
Inyo	130.61	3,823.90	7.45	464.40	4,295.75	4,426.36
Kern	4.16	54,242.11			54,242.11	54,246.27
Lassen and Los Angeles	3.63	7,493.71			7,493.71	7,497.34
Madera		3,140.70			3,140.70	3,140.70
Mariposa	118.08	20,846.18			20,846.18	20,964.26
Mendocino	1.98					1.98
Modoc		1.26			1.26	1.26
Monterey	60.37	6.05			6.05	66.42
Mono	14.51	15,076.45			15,076.45	15,090.96
Nevada	16,962.05	131,887.70			131,887.70	148,849.75
Placer	19,412.73	5,671.86	710.63		6,382.49	25,795.22
Plumas	4,444.79	8,601.55	14.51		8,616.06	13,060.85
Riverside		287.20			287.20	287.20
San Bernardino	502.42	20,514.66			20,514.66	21,017.08
Santa Barbara	33.86					33.86
San Diego	241.88	4,025.37			4,025.37	4,267.25
Sacramento	31,473.96					31,473.96
Shasta	706.95	27,511.76	5,969.76		33,481.52	34,188.47
Sierra	6,246.03	18,491.67			18,491.67	24,737.70
Siskiyou	19,873.69	17,011.59			17,011.59	36,885.28
Stanislaus		2,418.75			2,418.75	2,418.75
Trinity	20,521.09	17,019.62			17,019.62	37,540.71
Tulare		191.66			191.66	191.66
Tuolumne	647.94	62,185.76			62,185.76	62,833.70
Yuba	12,658.03	859.19			859.19	13,517.22
Total	285,029.17	617,856.11	10,867.46	464.40	629,187.97	914,217.14
Increase (+) or decrease (−).	+43,844.36	−17,690.96	−13,859.58	+439.24	−31,111.30	+12,733.06

In view of the fact that the principal increase in gold production for the year is from placers, an analysis of the latter showing the source of this gold with reference to kinds of mining will be of interest.

Hydraulic mines are operated in 16 counties of the State. The largest ones are in Trinity and Siskiyou counties, where are the largest number also. In these connties the débris passes off into nonnavigable rivers, and there are no Federal or local restrictions as to disposition of these tailings. The same is the case in Humboldt and Del Norte counties. In Amador, Butte, Eldorado, Nevada, Placer, Plumas, Sierra, and Yuba connties the débris is impounded and not allowed to escape so as to reach ultimately any navigable streams. Licenses must be obtained from the California Débris commission before this class of mining may be carried on in the drainage basin of the Sacramento and San Joaquin rivers, and restraining dams must be constructed. For this reason the output of all the claims in these counties named is more or less restricted, and comparatively few of such mines are now worked on any scale of magnitude. Trinity is the most productive of the hydraulic-mining counties, and it also has the largest and most productive mine of this character in the State, and, in fact, in the United States. Siskiyou county comes second in amount of output for the year. In none of the older mining counties where the Caminetti law applies, requiring impounding dams, does the hydraulic-mining output of any one mine for the year reach $100,000, and in only two does it run over $80,000. The hydraulic mines of California yielded $53,043 less than in 1904, and this particular branch of gold mining is not making progress in the State.

The drift mines, which yielded $815,242 for the year under review, show a falling off in output for the year of $118,712. The principal drift-mining counties are Nevada, Placer, and Butte, although this kind of mining is carried on in 15 counties of the State. Some of the old hydraulic mines of Nevada County are now being drifted, which accounts for the increase of yield from that source in the county. Placer County, usually considered the principal drift-mining county of the State, shows a material falling off in returns for the year—$146,040. Nevada and Butte increased.

The gold-dredging industry shows a marked advance in yield, the increase for the year being $1,089,105. All the counties where dredging is carried on show a larger output except Trinity. A comparative statement of production for 1904 and 1905 is as follows:

Output of gold from dredging operations in California in 1904 and 1905, by counties.

County.	1904.	1905.	Increase (+) or decrease (−).
Butte	$1,632,507	$2,261,888	+ $629,381
Calaveras	115,951	202,505	+ 86,554
Eldorado	....	41,547	+ 41,547
Sacramento	348,990	569,125	+ 220,135
Siskiyou	6,827	7,111	+ 284
Trinity	8,500	5,000	− 3,500
Yuba	74,263	188,967	+ 114,704
Total	2,187,038	3,276,143	+ 1,089,105

It appears from this table that Butte is still the leading county in the dredging industry. It has by far the largest number of dredges and the largest output, and it shows the greatest increase in yield. The principal point is Oroville, which is, in fact, the only place in the county where these machines are operated. Sacramento County comes second in importance, the dredges being located in the Folsom district. The Yuba County field has many machines of the largest size and more are being built. Only a few of them had commenced operating at the end of 1905. It is predicted that this field will ultimately eclipse in annual output the field at Oroville, when all the projected dredges are actively at work. The other dredging districts of the State are as yet unimportant.

At one time the hydraulic-mining industry was the most important of those dealing with the auriferous gravels, but later the drift mines became somewhat more important in the matter of actual yield. It is noteworthy that now the dredging interests have so far eclipsed the other placer interests that the dredges are producing $461,205 more than the hydraulic, drift, and surface placers combined—a result which would hardly have been predicted a few years ago. It is also worthy of note that, although many persons supposed the placer mines of California virtually worked out years ago, the gold produced in 1905 by the various methods of working these superficial deposits amounted to $5,892,081, the increase over 1904 being $906,791, due to the increased output of the dredges.

As to the surface placers, while the yield for the year was slightly less than in 1904, yet the total output aggregates $825,556. The largest amounts come from the counties of Siskiyou, Butte, and Placer, each of which was over the hundred thousand dollar mark. There are 27 counties in which surface placers are still worked by sluicing, etc., to a greater or less degree, and in these counties there are 286 active and yielding mines of this kind. The following table shows in detail, by counties, the source of the placer gold:

Source of placer gold in California in 1905, by counties.

County.	Hydraulic.	Drift.	Dredging.	Surface placers.	Total.
Amador	$2,262	$420		$47,099	$49,781
Butte	48,039	133,567	$2,261,887	136,804	2,580,297
Calaveras	38,596	40,988	202,505	19,913	302,002
Del Norte	2,750			4,009	6,759
Eldorado	2,900	58,685	41,547	27,788	130,920
Fresno				853	853
Humboldt	33,694			16,530	50,224
Inyo				2,700	2,700
Kern				86	86
Los Angeles				75	75
Mariposa		336		2,105	2,441
Mendocino				41	41
Mono	150			150	300
Monterey				1,248	1,248
Nevada	87,712	220,365		42,559	350,636
Placer	93,481	200,979		106,837	401,297
Plumas	9,613	12,406		69,863	91,882
Santa Barbara				700	700
San Bernardino				10,386	10,386
San Diego				5,000	5,000
Sacramento		45,000	569,124	36,500	650,624
Shasta	900	900		12,814	14,614
Sierra	41,734	77,077		10,306	129,117
Siskiyou	228,291	13,286	7,111	162,137	410,825
Trinity	370,034	1,500	5,000	47,675	424,209
Tuolumne	2,000	8,376		3,018	13,394
Yuba	12,984	1,355	188,967	58,359	261,665
Total	975,140	815,240	3,276,141	825,555	5,892,076
Increase (+) or decrease (−)	−53,043	−118,712	+1,089,105	−10,559	+906,786

As to silver output the returns for the year show a falling off of $193,927 from 1904, the total output having been 1,074,173.84 ounces, valued at $650,009. The second table in this chapter gives the aggregate yield by counties. The following table gives the source of the silver by classes of ores. The placers, the siliceous ores, and the lead ores each show increases, but the great deficit from the copper ores causes the decrease of over 400,000 ounces for the year. This is mainly due to the cessation of operation of certain Shasta County properties during the year.

Source of silver product in California by kinds of ore in 1905.

[Fine ounces.]

County.	Placers.	Deep mines.				Grand total.
		Siliceous ores.	Copper ores.	Lead ores.	Total.	
Alpine		2			2	2
Amador	438	20,982			20,982	21,420
Butte	10,652	255			255	10,907
Calaveras	1,440	12,001	92,252		104,253	105,693
Del Norte	60					60
Eldorado	694	2,559			2,559	3,253
Fresno	7	354	14,569		14,923	14,930
Humboldt	346					346
Inyo	13	30,516	616	53,477	84,609	84,622
Kern		170,469			170,469	170,469
Lassen and Los Angeles		3,503			3,503	3,503
Madera		2,048			2,048	2,048
Mariposa	20	6,743			6,743	6,763
Monterey	7					7
Mono		15,876			15,876	15,876
Nevada	1,533	39,596			39,596	41,129
Placer	1,863	9,074	18,240		27,314	29,177
Plumas	493	1,278	76		1,354	1,847
Riverside		91			91	91
San Bernardino	55	66,914			66,914	66,969
Santa Barbara	3					3
San Diego	33	10,045			10,045	10,078
Sacramento	2,745					2,745
Shasta	89	8,025	262,416		270,441	270,530
Sierra	520	12,581			12,581	13,101
Siskiyou	2,939	4,379			4,379	7,318
Stanislaus		828			828	828
Trinity	2,218	3,759			3,759	5,977
Tulare		598			598	598
Tuolumne	83	18,993			18,993	19,076
Yuba	1,116	129			129	1,245
Undistributed		165,563			165,563	165,563
Total	27,367	607,161	388,169	53,477	1,048,807	1,076,174
Increase (+) or decrease (−)	+24,874	+22,663	−456,096	+4,144	−429,290	−404,415

The following tables give the relative rank of the counties of California in the matter of gold, silver, and copper production for 1905:

Rank of counties producing gold in California in 1905.

County.	Value.	County.	Value.
Nevada	$3,077,000	Shasta	$706,739
Butte	2,590,888	Sacramento	650,625
Amador	2,420,163	Placer	533,235
Calaveras	1,780,487	Sierra	511,374
Tuolumne	1,298,889	San Bernardino	434,462
Kern	1,121,371	Mariposa	433,370
Trinity	776,036	Eldorado	385,596
Siskiyou	762,487	Mono	311,958

Rank of counties producing gold in California in 1905—Continued.

County.	Value.	County.	Value.
Yuba	$279,426	Del Norte	$6,759
Plumas	269,992	Riverside	5,937
Lassen and Los Angeles	154,984	Tulare	3,962
Inyo	91,501	Monterey	1,373
San Diego	88,212	Santa Barbara	700
Madera	64,924	Alpine	360
Humboldt	50,224	Mendocino	41
Stanislaus	50,000	Modoc	26
Fresno	35,461		

Rank of counties producing over $1,000 in silver in California in 1905.

County.	Value.	County.	Value.
Shasta	$163,400	Sierra	$7,913
Kern	102,963	Butte	6,588
Calaveras	63,838	San Diego	6,087
Inyo	51,112	Siskiyou	4,420
San Bernardino	40,449	Mariposa	4,085
Nevada	24,842	Trinity	3,610
Placer	17,623	Lassen and Los Angeles	2,116
Amador	12,938	Eldorado	1,965
Tuolumne	11,522	Sacramento	1,658
Mono	9,589	Madera	1,237
Fresno	9,018	Plumas	1,116

Rank of counties producing over $1,000 in copper in California in 1905.

County.	Value.	County.	Value.
Shasta	$1,688,614	Inyo	$23,650
Calaveras	572,022	San Bernardino	8,206
Fresno	224,640	Mariposa	1,956
Placer	57,291	Amador	1,560
Eldorado	24,960		

PRODUCTION BY INDIVIDUAL COUNTIES.

Of the 57 counties of California 34 produce gold, 32 silver, 11 copper, 1 lead, and 9 platinum. The preceding tables show the general conditions in the counties. In this section the county will be considered the unit, though some counties will be grouped for reasons apparent in the respective descriptions.

THE MOTHER-LODE COUNTIES.

These include the counties of Amador, Calaveras, Eldorado, Mariposa, and Tuolumne. There were in 1905 in these 5 counties 148 productive deep mines and 72 placers. Of the deep mines yielding gold, 5 produced copper, and all of them more or less silver. There were 1,626,320 short tons of ore produced by the deep mines, averaging $4.01 per ton, or a total of $6,514,791. The placers of these counties produced $498,538. The copper output was valued at $600,499. No lead was produced and only $47 worth of platinum. The total metallic output of these mother-lode counties was therefore $7,613,875.

The following table shows the increase or decrease in the metallic production of the 5 mother-lode counties in 1905 as compared with 1904:

Increase (+) or decrease (−) in production of metals in mother-lode counties, California, in 1905 as compared with 1904.

Year.	Gold.		Silver.		Copper.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ounces.		*Fine ounces.*		*Pounds.*		
1905	−514.71	−$10,640	−4,461.37	−$2,588	+1,214,191	+$320,793	+312,741

Amador County.—Amador County had a total yield in 1905 of $2,434,361, of which $2,420,161 was gold, making it third in rank of the gold-producing counties. This was an increase in gold alone of $339,362 over 1904, and there was also an increase of silver value of $6,363. The county has the distinction of having produced and crushed more tons of ore than any other in the State—649,693 tons—which is 123,622 tons more than in 1904. This record was made by 25 deep mines. The average value of the ore was $3.67 per ton, or $2,384,613 in all. From this ore 10,033 tons of concentrates were produced, yielding $782,973, which is twice as much as any other county in the State produced. There are in the county 36 mines reporting product, 25 of them deep, and 11 placers, but there are 104 nonproducing mines. The gold came mostly from siliceous ores. The placers of the county yielded altogether $47,781 gold and a small amount of silver, and these are at Ione, Lancha Plana, Oleta, Pine Grove, Plymouth, Sutter Creek, and Volcano. The most productive mine is the Kennedy Mining Company at Jackson, which has a 100-stamp mill and the deepest shaft in the State. The principal quartz mines are the Keystone and the Bunker Hill, at Amador City; the Defender, at Defender; the Fremont Consolidated, at Drytown; the Argonaut, the Kennedy, the Oneida, and the Zeila, at Jackson, and the Central Eureka and the Wildman-Mahoney, at Sutter Creek. The number of stamps operating in the county is 416.

Calaveras County.—Calaveras, which adjoins Amador County, has a record for the year of a total output of $2,416,345, of which $1,780,485 was gold, $63,838 silver, and $572,022 copper. The county did not produce so much gold and silver as in the previous year, but its copper output increased 1,055,150 pounds, valued at $294,857. The copper mining industry of the county is becoming yearly of more and more importance, and a still further increase is expected for 1906. There are 32 deep producing mines in Calaveras, from which were taken in 1905 547,972 tons of ore of a total average value per ton of $3.86. From this ore were obtained 8,275 tons of concentrates, valued at $353,905, and $17,240 came from old tailings. Altogether 56 mines reported product, 30 deep gold mines, 2 copper, and 24 placers, which includes 2 dredges. The placers show a yield for the year of $302,002, of which $202,505 came from 2 dredges. Quite a large quantity of silver came from this county, 92,252 fine ounces being derived from copper ores, 12,001 ounces from siliceous ores, and 1,440 ounces from placers. The principal placers mined in the county are the Calaveras Gold Dredging Company, at Jenny Lind, and the Mokelumne Mining Company, at Wallace, both operating gold dredges; the Nelson Contracting Company's hydraulic mine, at San Andreas; the Reed and the Eastland-Gray Mining companies, at San Andreas, both drift mines; the What Cheer drift mine, at Mokelumne Hill, and the Idlewild placer, at Wallace. Of the deep mines the most productive one in the county is now the Satellite, at Campo Seco, owned by the Penn Chemical Works, a copper property producing also both gold and silver. It has 2 smelters, 1 of 100 and the other of 80 tons capacity. The next is the famous Utica, at Angels, which is a gold mine. Other large producers are the Lightner Mining Company and the Angels Mining Company, at Angels; the Gwin Mine Development Company, at Gwinmine; the Royal Consolidated Mines Company, at Hodson; the Melones Mining Company, at Melones, and the Sheep Ranch Mining Company, at Sheep Ranch. There are 632 stamps dropping in this county. Of the large mines the Utica has 140 stamps in its mills, the Royal has 100, the Gwin 100, and the Melones 100.

Eldorado County.—Eldorado County had a total yield for the year of $412,521, of which $385,596 was gold, $1,965 silver, and $24,960 copper. In all three of these metals some increase is shown for the year. The tonnage of quartz milled was considerably less than in the previous year, but the average yield per ton in gold and silver and the total average yield increased. There are 29 deep mines producing and an equal number of placers. In the latter are 11 drift mines, 1 dredge, and 13 surface placers. There is 1 copper mine in the county. There are 144 nonproducing mines as against 58 reporting product. The placer mines yielded in gold $130,920 and the quartz mines $254,676. The principal deep mines are the Rio Vista Gold and Copper Company, at Fairplay; the Mother Lode Exploration Company, at Nashville, and the River Hill Mining Company, at Placerville. There are no very large quartz mills in the county. The largest producing placers are the El Dorado Gold Dredging Company, at Fair Oaks; the Landecker Mining Company, the Live Oak Mining Company, and the Rivera mine, at Placerville.

Mariposa County.—Mariposa County shows a record for the year of $433,370 gold and $4,085 silver, with $1,956 copper and $25 platinum. In each of these metals there was an increase shown. Of the gold, $430,929 came from quartz operations and $2,441 from placers. There were more deep mines producing in the county than in the previous year, but there was less tonnage produced. The average yield per ton increased somewhat. There are only 4 placers worked in the county, 2 of them drift and 2 sluicing mines, and there are 22 deep gold mines and 1 copper property. There are 71 nonproducing mines on record. The gold from the deep mines was derived entirely from siliceous ores. The few placers are at Baxter, Coulterville, Kinsley, and Whitlock. There is only one large quartz producer in the county, the Mariposa Mining and Commercial Company, of Mount Bullion, which operates mines on the famous Fremont grant. The Ruth Pierce Mining Company, at Hornitos; the Hite, at Jerseydale, and the Austin Group Mining Company, at Whitlock, are among the mines making a moderately good yield. There are 174 stamps in the operating mills of the county, one company having 75 of them.

Tuolumne County.—Tuolumne County produced in 1905 $1,310,410, of which $1,298,888 was gold and $11,522 silver. Of the gold, $1,285,494 came from quartz mines and $13,394 from placers. All of the silver except $50 came from deep mines. Both gold and siver show a falling off from the previous year, the decrease of gold having been $357,658; and while virtually the same number of deep mines were worked there were 56,783 less tons of ore worked than in 1904, and the average values per ton in gold and silver were less. From the 303,631 tons of ore worked there were obtained 2,422 tons of concentrates, valued at $253,383, making the county fourth in rank in the matter of concentrate production. There are 39 deep producing mines in the county and 4 placers, while 110 recorded mines are at present unproductive.

At Big Oak Flat the principal producing deep mine is the Longfellow, followed in point of value of output by the Mack mine of the Big Casino Gold Mining Company. At Carters the main producers are the Los Angeles, the Lilian (Mohican Mining Company), and the Providence. At Chinese Camp is the most productive mine in the county, the Eagle-Shawmut Mining Company. At Columbia there are no producers over $10,000. At Confidence the Confidence Mining Company is the second largest producer in the county. At Groveland the leading mine is the Jefferson, and the Clio and the Republican mining companies are the leaders at Jacksonville. The Rawhide is the main producer at Jamestown, as is the Dutch mine at Quartz. At Sonora there are many pocket mines, but no very large producers. In Soulsbyville are the Black Oak, the Draper, and the Soulsby, the first named having the heaviest output. The Jumper, at Stent, no longer has the large annual output as formerly, but is still productive. Some of the large properties in this county formerly yielding very large amounts materially decreased their outputs in 1905, which accounts for the falling off in gold product for the year.

BUTTE COUNTY.

Butte County produced $2,590,886 in gold and $6,588 in silver in 1905. Of this $2,580,297 gold came from placers, and only $10,589 from quartz mines. This county is the center of the gold-dredging industry in the State. There were more dredges at work near Oroville than in any other part of the United States, Oroville being the point where the gold-dredging industry was inaugurated and where it has made the greatest success. The county shows a much larger increase in its output over 1904 than any other in the State, the amount being $644,301 gold, $4,342 silver, and $725 platinum. The deep mines interests have languished since the working out of the Gold Bank mine at Forbestown a few years ago, and the 10 deep mines of the county only yielded a little over a thousand tons of ore in 1905, worth about $10 per ton. The decrease of ore output for the year is over 10,000 tons. Out of the 82 mines reporting product for the year, 72 were gold placer mines. Of these 5 were hydraulic mines, 15 dredging companies, 13 drift mines, and 39 surface placers. There are 112 nonproducing mines on the records.

The source of placer gold in Butte County for the year is as follows: Dredging, $2,261,887; surface placers, $136,804; drift mines, $133,567; hydraulic mines, $48,039; total, $2,580,297. As will be noted, dredging is by far the most important branch of the gold-mining industry. The growth of dredging interests in Butte County may be shown for the last three years as follows:

Production of gold by dredging in Butte County, Cal., 1903–1905.

Year.	Yield from dredging.	Increase.
1903	$1,329,998	....
1904	1,632,507	$302,509
1905	2,261,888	629,381
Total	5,224,393	931,890

As the subject of gold dredging was treated somewhat extensively in the report for 1904, it is not necessary to go into much detail at this time. The dredging companies are increasing the number of their machines; and the new ones are generally larger than those of a few years ago, and they dig deeper and "stack" higher.

DEL NORTE AND HUMBOLDT COUNTIES.

These two counties are in the northwest coast of the State, where placer mining alone is carried on, neither of the counties having any producing deep mine. In fact, in Del Norte there are only 9 mines reporting a total product of $6,817. In Humboldt 24 mines report a total output of $50,637 for the year. In Del Norte there are 5 surface placers and 4 hydraulic mines, and in Humboldt 15 productive hydraulic mines and 9 surface placers. In both counties black-sand mining is done on the ocean beaches.

FRESNO COUNTY.

The total output of Fresno County for 1905 is valued at $269,119, of which $224,640 is from copper, the gold only amounting to $35,461 and silver to $9,018. There are 4 deep producing mines in the county, their total output being 12,525 tons of ore. The average value in gold and silver per ton is $3.48, but the average total value per ton is $21.42. Three of the mines are worked for gold and 1 for copper. There are 2 small surface placers. There were, therefore, only 6 producing mines in the county in 1905, but 27 nonproductive mines are on record.

INYO COUNTY.

This county shows an increase in output of silver, copper, and lead, but the gold output is lessened from the previous year. The total for the county was $187,307, of which $91,501 was gold. The county also yielded $51,112 silver and $21,043 lead, as well as $23,651 in copper. There are 22 deep producing mines, from which were derived 8,907 tons of ore, with an average total value of $20.73 per ton. There are only 2 small placers, and there are some 70 nonproductive mines on record. The county has of late received marked attention by reason of copper discoveries in the desert and mountain region, and it is attracting large numbers of prospectors and miners.

KERN COUNTY.

This is known as one of the "desert" mining districts of the State, and is one of 7 counties having to their credit an output of over a million dollars each. In 1905 the output was $1,224,333, which is, however, considerably less than the yield of the previous year, both in gold and silver. The tonnage from the deep mines was increased by 35,123 tons, and about the same number of mines were operated; but the average value of the ores mined fell off from $7.53 to $4.84 per ton, according to the returns received. There are 45 producing deep mines and only 1 placer. The gold came almost altogether from siliceous ores, as did the silver.

There are 4 deep mines in the county, each of which yields over $100,000 a year—the Yellow Aster, at Randsburg; the Lida, at Rosamond; and the Exposed Treasure and the Queen Esther, at Mohave. Other important mines are the Cowboy, at Amalie; the Arondo, at Johannisburg; the Echo, at Mohave; the McRae, at Paris; the Butte Lode, the Sidney Annex, the Sunshine, and the Stanford, at Randsburg. Smaller mines are worked at Havilah, Isabella, Kernville, Keyes, Piute, Weldon, and Woody. The Yellow Aster, at Randsburg, is one of the most notable producers in the State, and has been so for a series of years. It is notable that some $9,000 worth of tungsten was produced in this county in 1905, and several mines of this character are being developed.

MADERA COUNTY.

This county only yielded $66,161 in 1905, the output containing less gold and more silver than in 1904. There are only 8 deep mines, with an output of 5,380 tons of ore, averaging a total value of $12.30 per ton, the ledges being small, but the grade of ore rather high. No placer mine reported production. Thirty-nine nonproducing mines reported. All the gold came from siliceous ores. The producing mines are at Ahwahnee, Coarse Gold, Grub Gulch, and O'Neals.

MONO COUNTY.

Mono County shows a total yield of $321,547, of which $311,958 was gold and $24,842 silver. This was from 11 deep mines and 2 placers, the yield from the latter being nominal. The returns show an increase of $45,672 gold and a falling off of a few hundred dollars in silver. There were 11 deep mines worked, with an average total value per ton of ore of $13.70, as against $12.36 in 1904. Some 1,120 tons of old tailings were worked, valued at $8,234. The gold was virtually all from siliceous ores. The only prominent producing mine in the county is the Standard Consolidated Mining Company, at Bodie. The New Bodie Mining Company, at the same camp, and the Crystal Lake Gold Mining Company, at Lundy, are two other important mines, and some little production comes also from Bridgeport and Colville.

NEVADA COUNTY.

This county has for some years enjoyed the distinction of being the largest gold producer of the State, and it again in 1905 leads all other counties, with a yield of $3,076,997. A comparison with the previous year shows as follows:

Production of gold, silver, and platinum in Nevada County, Cal., in 1904 and 1905.

Year.	Gold.	Silver.	Platinum.
1904	$2,931,114	$12,346	....
1905	3,076,997	24,842	$20
Increase	145,883	12,496	20

This shows the very substantial gain for 1905 of $158,399. There are 43 producing deep mines, some of them the most important in the State. Of the 22 placers, 6 are hydraulic, 7 drift, and 9 surface placers. There are 102 nonproducing mines listed.

In tonnage from deep mines this is the third county in the State, being exceeded only by Amador and Calaveras. The total ore milled in 1905 was 325,266 tons, which is 67,246 tons more than in 1904. The average value per ton, however, was lower, being $8.46 in 1905 as compared with $10.20 in 1904. The ore contained 5,537 tons of concentrates, which yielded $309,850. The total quartz gold, including this, was $2,726,361, and the quartz silver was $23,916. The gold obtained came entirely from siliceous ores and placers. Of the total gold output from this county $350,636 was derived from placers, $87,712 being from hydraulic mines, $220,365 from drift, and $42,559 from surface placers. The output from the drift mines was larger than that of any other county in the State, exceeding even Placer County. Most of the silver was derived from the siliceous ores of the deep mines.

The gold mines at Grass Valley and Nevada City are the most productive in the State. The North Star at Grass Valley made the largest individual output of any mine in California in the year under review, and the Empire in the same camp came second. Other heavy producers at Grass Valley are the Pennsylvania, the Brunswick, and the Sultana; and among smaller producers are the New York-Grass Valley, the Ben Franklin, the Idaho-Maryland, and the Orleans. In Nevada City the Champion is the largest producer, while other producers of moment are the Glencoe, the Gaston Ridge, the Home, the Lecompton, the Murchie, the Mountaineer, the Oustomah, and the Pittsburg. A comparative statement of output of the mines at these adjoining towns for the last two years is as follows:

Output of gold and silver in Grass Valley district, California, in 1904 and 1905.

Year.	Grass Valley mines.			Nevada City mines.		
	Gold.	Silver.	Total.	Gold.	Silver.	Total.
1904	$1,738,979	$6,317	$1,745,296	$683,552	$3,400	$686,952
1905	2,041,447	10,843	2,052,290	440,236	12,531	452,767
Increase (+) or decrease (−)	....	....	+306,994	....	....	−234,185

By this is seen that the Grass Valley mines increased their output for the year by $306,994, and that the Nevada City mines show a decrease of $234,185. This latter fact is explained by the reduction of output from the largest producer by reason of litigation. These combined camps yielded in the year under review $2,505,057 in gold and silver, out of a total yield of the county of $3,101,859, the balance of $596,802 coming from other districts in the county. At Gaston the principal deep mine is the Gaston Mining Company. At Graniteville there are no important mines; at Maybert the Grey Eagle Mining Company is the largest producer; at North Columbia the Consolidated St. Gothard is the leader, and at Washington the Ethel Mining Company produces the most. There are 597 stamps in the mills in this county.

As to placer mines, the most productive one in the county is the Black Swan drift owned by the Excelsior Company. Next in point of production are the North Bloomfield drift at North Bloomfield, and the Badger Hill hydraulic, at North San Juan. Other noteworthy producing placers are the Esperanza drift at French Corral; the Liberty Hill hydraulic, at Lowell Hill; the Blue Tent drift, at Nevada City; the Union Blue Gravel drift, and the Waukenshaw drift at North Bloomfield; and the Omega hydraulic at Washington. Most of these drift mines were formerly worked by hydraulic process, when the laws were not unfavorable to the latter system.

PLACER COUNTY.

Placer County produced gold to the value of $533,235; silver, $17,623; copper, $57,291, and $36 in platinum, a total value for the year of $608,185. There was an evident falling off in both gold and copper, but an increase in silver and platinum. Of a total of 80 mines reporting production only 19 are deep mines, one of them being a copper property. Of the 61 placers, 22 are drift mines, 13 hydraulic, and 26 surface placers. The placer mines of the county yielded for the year $401,297 in gold, of which $200,979 came from drift mines, $106,837 from surface placers, and $93,481, from hydraulic properties. It is probable that some of the gold reported as from "placers" was really derived from drift and hydraulic mines, as the answers to inquiry in this respect were not always exact. Moreover many of the "small mines" of different kinds were classed as "placers." The most productive drift mine is the Hidden Treasure, at Bullion (Michigan Bluff); it makes the largest output of any auriferous gravel mine in the county, exceeding also that of any of the deep mines. This has the reputation of being the most extensive mine of its character in the world. Other gravel mines of note are the Davis hydraulic, at Auburn; the Lost Camp, in Blue Canyon; the Liberty Hill and the Polar Star, at Dutch Flat; the Acacia (or Bob Lewis) drift at Damascus; the Reamer Consolidated drift, the Auburn (or Buckeye) drift, and the Haub drift, at Forest Hill; the Inskip hydraulic, the Washington and Kearsarge hydraulic, the Cement Hill drift, the Indian Bar drift; and the Gold Run Gravels (hydraulic) at Gold Run; and the Gleason drift and the Morning Star, at Iowa Hill. Other gravel mines of less note are worked at Butchers' Ranch, Colfax, Emigrant Gap, Loomis, Towle, Todd, Weimer, Westville, and Yankee Jims.

Of the deep mines the most productive is the Dairy Farm, at Van Trent, which is worked for copper, but yields also gold and a large proportion of the silver of the county. Next in importance is the Three Stars mine, at Ophir, followed in rank by the Rawhide, at Towle. These are really the only deep producers of note, though 18 altogether are at present productive. There are only about 130 stamps in the operating mines of the county, as far as the returns show. There were 23,939 tons of ore crushed of an average value of $8.59 per ton; both the average value and the quantity of the quartz output were less than in 1904, though the number of deep mines producing is about the same. From this ore $5,534 worth of concentrates were obtained in addition to the free gold.

PLUMAS COUNTY.

This is one of the prominent gravel mining counties of the State, though not now relatively so important in this respect as when hydraulic mining was permitted without restrictions. There are 71 productive gravel mines in the county, of which 47 report as surface placers, 13 as hydraulic, and 11 as drift. The total gold yield from these was $91,882, of which $69,863 came from surface placers, $12,406 from drift, and $9,613 from hydraulic properties. The total gold yield from all the various mines was $269,992; silver, $1,116; copper, $166, and platinum, $36. There are only 16 deep mines reporting production, but they crushed 31,455 tons of ore, yielding $179,094 including $6,677 in concentrates. As the total yield of the county for the year was $271,274, it will be will be seen that the largest proportion of gold, silver, etc., came from the quartz properties, namely, $179,356 in gold as compared with $91,882 from all classes of placers. By far the most productive quartz mine in the county is the Jamieson, at Johnsville, the same camp where the famous Plumas-Eureka—now nonproductive—produced so much gold when actively worked. The next in importance is the White Lily, at Seneca, followed in order of yield by the North Canyon and the New York companies at Greenville. There are no others of special note unless it be the Gruss or Genesee Valley Mining Company at Genesee. There are a few small quartz producers at Buck, Clio, Crescent Mills, and Taylorville, as well as at the other camps previously named. Of the 71 productive gravel mines there is none which is a large producer, most of the operations in this line being on a small scale. Gravel mines are operated at Beckwith, Buck, Clio, Crescent Mills, Eclipse, Genesee, Johnsville, Laporte, Longville, Lumpkin, Meadow Valley, Mohawk, Nelson Point, Quincy, Seneca, Spanish Ranch, and Taylorsville. The building of the Western Pacific Transcontinental Railroad through this county, now in progress, is expected to revive greatly the mining industry in all branches, especially in copper. Numerous copper mines are being developed in and around Taylorsville and when an outlet is afforded for their ores they will at once become productive. In some of the mountain valleys dredging projects are also being advanced, but as yet no dredges have been built.

SAN BERNARDINO COUNTY.

This county has only 15 productive mines at present, but some of them are making a large output, bringing the total yield for 1905 up to $483,116, of which $434,461 is gold, $40,449 silver, and $8,206 copper. There are only a few small surface placer mines, which are near Barstow and Daggett, most of the properties being deep mines. Of the latter, 8 are classed as gold mines, 3 silver, and 2 copper. By far the largest producer of both gold and silver is the Bagdad-Chase Gold Mining Company, at Stedman, this mine alone yielding over three-quarters of the gold of the county. The falling off in gold production from 1904 is quite notable, and copper is reduced in quantity also, though some material increase of silver is manifest. There is very little difference in the tonnage produced by the deep mines, but the average value per ton is much lower than in 1904; then the total average value per ton was $17.94 and the average value per ton in gold and silver was $17.51; in 1905 the average value in gold and silver was $13.65 and the total average value was $13.89. This serves to explain the falling off in gold yield for 1905 of $163,263. Aside from the small amount of gold from the few placers, the yield of this metal was from siliceous ores. With the exception of the Bagdad-Chase mines already mentioned, there are no very prominent producers among the deep properties, though mines are being worked with success at Bagdad, Daggett, Dale, Halleck, Manvel, Needles, Stedman, and Victorville. The recent rise in silver may result in reviving the mining interests in the Old Calico and other camps near Daggett.

SAN DIEGO COUNTY.

This county produced in 1905 only $88,212 in gold, $6,087 in silver, and $749 in copper, a total of $95,048, a falling off in gold of $244,473. This is mainly due to the lessened operations of the Golden Cross Mining Company, at Hedges; for some 38,036 less tons of ore were worked in the county, and there were only 6 deep mines producing, as compared with 11 the year before. The average total value per ton rose from $6.83 to $9.33 and the average gold and silver value per ton from $6.83 to $9.25. Of the total gold $53,612 came from working old tailings. The placer district, which produced gold valued at $5,000, is in the dry washing region around Picacho. The quartz gold was valued at $83,212, and the silver came almost entirely from the same source. The only quartz mines of moment are the Golden Cross, at Hedges, and the Julian Consolidated, at Julian, though small deep mines are worked at Banner, Escondido, and Ogilby. The copper came from Encinitas. The two largest quartz mines in the county have been involved in litigation, and this has hampered operations materially.

SACRAMENTO COUNTY.

By reason of the operations of dredges in recent years in the Folsom district the gold output of this county has been steadily increasing. In 1905 the yield of gold was $650,624, which is $239,906 more than in 1904. The silver and platinum have also increased. This large yield was entirely from auriferous gravels, no deep mines being worked in the county. Only 8 properties were productive, 4 of these being dredging companies (with one or more dredges), 2 drift mines, and 2 surface placers. The gold product from the dredges was $569,124, from the deep mines $45,000, and from the surface placers $36,500. The $1,658 silver was all from the gravels, as was the $700 worth of platinum, this being obtained in dredging. One of the dredging companies is operating at Fairoaks and the other three are at Folsom. The dredges at this point are generally larger than those in use at Oroville, and therefore have greater individual capacity. The Folsom Development Company, the largest producer in the county, has several machines at work, and is extending its operations. The drift mines of the county are not so productive as formerly, some of the companies having worked out their channels.

SHASTA COUNTY.

Shasta is the leading copper-producing county of the State, but yields as well much gold and silver, which are largely produced in connection with the copper-smelting operations where the siliceous ores are used as flux. For the same reason more silver is produced in this county than elsewhere in California, some of the ores thus utilized carrying considerable silver, as does the copper ore itself. The total output of the county in 1905 was valued at $2,559,753, being exceeded only by the counties of Nevada and Butte. Of this yield $706,738 was gold, $163,400 silver, and $1,689,615 copper (10,830,865 pounds). This is less copper by 15,607,280 pounds in quantity and $1,713,903 in value than in 1904, a condition explained by the cessation of smelting operations by the Mountain Copper Company in the county, owing to litigation over alleged damages by fumes. The company has not again started up its smelters in Shasta County, but has built a new plant on the shores of San Francisco Bay, above Martinez, in Contra Costa County, to which ores from its mines are shipped for treatment. This also caused a reduction in output of $325,429 in gold and of $236,286 in silver from 1904. The county shows, therefore, a total falling in yield of $2,274,617, the output of the year before having been $4,834,370. The tonnage was less by 90,964, and 26 deep mines report yield, as compared with 35 in 1904. The average value per ton in gold and silver dropped from $4.62 to $4 and the average total value per ton from $15.77 to $11.89. A total of 214,036 tons of ore were treated, which yielded $2,545.085 in gold, silver, and copper. Of the 26 deep mines 4 were copper and 22 were gold and silver. Most of the silver is credited to the copper ores, 262,416 ounces being assigned to that source, 8,025 ounces to the siliceous ores, and 89 ounces to the placers. This is upon the face of the returns, but it is impossible to ascertain with exactness how much of the silver actually came from the siliceous ores used as flux mixed with the copper ores for that purpose and how much from the copper ores themselves.

As to placers, there are only 10 in the county, 8 being surface placers, 1 a drift, and 1 a hydraulic mine. The gold yield from this source was $14,614 and the silver $54. These placers are at Baird, Copley, French Gulch, Igo, Lamoine, Larkin, and Winthrop.

The largest producer of copper in Shasta County in 1905 was the Bully Hill Mining Company, at Winthrop, followed as a close second by the Mountain Copper Company. The Mammoth Copper Mining Company, of Kennett, comes next in order, and then the Great Western Gold Company at Ingot. All these copper companies have their own smelting plants, the Mountain Copper Company having two—one in Shasta and the other in Contra Costa County, as heretofore explained. The Bully Hill also shows the largest silver output. Of the deep gold mines the Gladstone mine of the Hazel Mining Company, at French Gulch, is much the largest producer, the Midas Mining Company, at Knob, being second in rank. Other gold producers of prominence are the Original Quartz Hill and the Utah and California Mining companies, at Buckeye; the American, the Brown Bear, and the Washington, at French Gulch; the Sunny Hill claim of the Marino Marsicano Mining Company, at Ono; and the Central, the Evening Star, and the Reid, at Whitehouse.

SIERRA COUNTY.

This mountain county has always been famous for its drift and hydraulic mines, but at present its gold output from quartz mines is three times that from the auriferous gravels. The total yield in 1905 was $519,286, of which $7,913 was silver and the remainder gold. The quartz mines produced $382,257 gold and $7,599 silver, and the placers yielded $129,117 gold and $314 silver. The deep-mine gold came from siliceous ores, no copper or lead ores having been produced in the county. Of the placer gold $77,077 came from drift mines, $41,734 from hydraulic mines, and $10,306 from surface operations. The increase in gold output for the year is $131,251 and that of silver $6,366. Although there were 12,009 less tons of ore produced than in 1904 from virtually the same number of deep mines the average values per ton for 1905 are very much higher, being $21.21, against $5.25 in 1904. A few thousand dollars were obtained by working over old tailings. There are 11 deep mines producing and 54 placers. Of the latter, there are 15 hydraulic, 29 drift, and 10 sluicing mines. The most productive gravel mine is the White Bear drift, at Downieville. Other gravel producers of note are the Golden Star drift, at Alleghany; the Hilda drift, at Sierra City; the New York hydraulic, at Sierra City; and the Captain Cook drift, at Tablerock. The largest deep-mine producer is the Croesus Gold Mining Company, at Alleghany. Next in order is the Tightner mine, at the same place, which is yielding higher grade rock than any mine in the State, though not in any great quantity. Some phenomenal crushings have been made of late. Other prominent deep mines are the Sierra Buttes, at Sierra City, lately reopened after abandonment; the Lassiat (or Empire Mining Company), at Downieville; and the Mountaineer, at Sierra City.

SISKIYOU AND TRINITY COUNTIES.

These two adjoining counties in the northwestern portion of the State are now the most important in California as regards hydraulic gravel mining, both being outside the limit of these sections where the Federal laws place restrictions upon the hydraulic mining industry. In these counties the general drainage of all the streams is into the Klamath River, which is nonnavigable, and the emptying of débris from such mines into it can do no damage. For these reasons, of the 227 productive hydraulic mines in the State, 139 are in these two counties, the other 88 being divided among the other 14 counties in which this branch of gold mining is carried on. In fact, out of the 658 placer mines of all kinds—hydraulic, drift, dredge, and surface—in the State, 205 are in these two counties, 130 in Siskiyou, and 75 in Trinity. Moreover, in total number of producing mines of all kinds, as compared with other counties, Siskiyou is first with 178 mines and Trinity is again second with 105. This is in number of mines only, several other counties exceeding each of these in gold and silver output for the year. The mines in these counties are small, the only large one being the La Grange hydraulic mine near Weaverville, Trinity County, which is the largest producer of its class in the State. No other single mine in either county produced over $75,000 in 1905. A statement of the outputs of these two counties for 1904 and 1905, with increase and decrease, is as follows:

Production of gold, silver, and platinum in Siskiyou and Trinity counties, Cal., in 1904 and 1905.

	Siskiyou.			Trinity.			Total.		
	1904.	1905.	Increase (+) or decrease (−).	1904.	1905.	Increase (+) or decrease (−).	1904.	1905.	Increase (+) or decrease (−).
Gold	$802,596	$762,486	−$40,110	$539,113	$776,035	+$236,922	$1,341,709	$1,538,522	+$196,812
Silver	1,144	4,420	+ 3,276	149	3,610	+ 3,461	1,293	8,030	+ 6,737
Platinum	16	93	+ 77	270	450	+ 180	286	543	+ 257
Total.	803,756	766,999	− 36,757	539,532	780,095	+ 240,563	1,343,288	1,547,095	+ 203,806

Taking Siskiyou County separately it is seen that its placer gold output in 1905 was $410,825 and its quartz gold $351,661, or a total of $762,486. The placer silver was $1,775 and the quartz or deep-mine silver $2,645, or $4,420 in all. This, with the $93 worth of platinum, gives the county the sum total of $766,999, as shown in the preceding table. There is a falling off in gold and an increase in both silver and platinum. There are in the county 130 auriferous gravel mines producing, of which 83 are hydraulic, 2 dredges, 7 drift, and 38 surface placers. As stated, this is the largest number of producing hydraulic mines in any of the counties. These hydraulic mines yielded for the year $228,291, the drift mines $13,286, the dredges $7,111, and the surface placers $162,137. Probably some of those reporting their mines as "surface" were in reality small hydraulic properties. The hydraulic mines, though greater in number than in Trinity County, did not yield so much in the aggregate, as there is no such extensive mine in the county as the La Grange in Trinity, which far overshadows all others in either county. The gravel mines yielding over $5,000 per annum each are the Salmon River, at Cecilville; the Siskiyou, at Elliotts Creek; the Bennett Company, the Knudson, the Crapo, and the Nordheimer, at Forks of Salmon; the Kuntz Flat, at Hamburg; the China Creek, the Happy Camp, and the Huey, at Happy Camp; the Garvey Bar, at Hornbrook; the Wright, at Oro Fino; Andrew Martin & Co., at Scott River, and Lowden or Lon Yick Company, at Seiad Valley. Other smaller operations in auriferous gravel are carried on at these places and at Black Bear, Callahans, Etna Mills, Fort Jones, Gazelle, Gottville, Greenview, Hawkinsville, Hilts, Nolton, Oak Bar, Rollin, Sawyers Bar, Somes Bar, Walker, and Yreka. The two dredges are operating near Callahans and Yreka. As to deep-mining work in the county, there are 48 producing mines of this kind more than in any other county of the State, and 14 more than there were in 1904. They produced altogether 31,846 tons of ore, with a yield of $5,140 more than in 1904, though the average value per ton fell off from $13.09 in 1904 to $11.13 in 1905. The gold from the deep mines of this county came entirely from siliceous ores. The most productive quartz mine in the county is the Morrison-Carlock, at Greenview, though not far behind it are the Dewey (Squaw Creek Mining Company), at Greenview, the Helena Mining Company, at Callahans, and the Highland, at Etna Mills. Other prominent producing quartz mines are the Taylor Lake Mining Company, at Etna Mills; the Golden Eagle and the Monarch Mining companies, at Fort Jones; the Providence claim of the Medina Mining Company, at Oro Fino; the Hickey, at Sawyers Bar; the Columbia, at Scott Bar; and the Punch Creek or Mono Mining Company, near Yreka.

Trinity County, like Butte, Del Norte, Humboldt, Monterey, Placer, Sacramento, Siskiyou, and Yuba counties, got more gold out of its auriferous gravels than from the deep mines. The gold from the placers in 1905 aggregated $424,209, and from the quartz $351,826. Only $3,610 in silver was reported, $2,210 of this from the deep mines; and the platinum amounted to $450. The county shows an increase of $236,922 in gold and $3,461 in silver over 1904. Producing mines to the number of 105 reported, which is, next to Siskiyou, the largest number in the State. Seventy-five of the producers are gravel mines, 56 of them being hydraulic, 17 surface placers, and 1 each of the drift and dredge properties. Of producing deep mines there are 38, all gold, there being no copper or lead mines. The county made the largest hydraulic mining output in the State, which is mainly due to the operations of the La Grange hydraulic mine, near Weaverville, the most productive in the State or on the Pacific coast. The output of these 56 hydraulic mines in 1905 was $370,034. The drift mines yielded only $1,500, but the surface placers or sluicing mines yielded $47,675. Outside of the La Grange hydraulic mine, already mentioned, the only other gravel mines of note and producing over $5,000 each are the Nash of the Trinity Placer Mining Syndicate, at Coffee; the Chapman and the Heurtevant, at Junction City; the Sykes hydraulic, at Trinity Center; and the Hupp and the Poverty Flat, of Weaverville. Smaller gravel mines are worked at these places as well as at Big Bar, Burnt Ranch, Carrville, Coleridge, Deadwood, Dedrick, Denny, Dorleska, Douglas City, Hayfork, Helena, Lewiston, and Minersville. The deep mines of the county yielded 40,468 tons of ore, which is 15,140 more than in 1904, though there were only 3 more mines at work last year. The grade of ore per ton, however, averaged $8.75, as against $7.51 in 1904. No yield from concentrates or old tailings was reported, and all the gold from the deep mines was from siliceous ores, there being no copper or lead yield. The most productive of the deep mines is the Fairview, at Minersville. Next in importance as to product is the Five Pines, at Trinity Center, followed in rank by the Dorleska (Union Consolidated Mining Company), at Dorleska; the Brown Bear, at Deadwood; the Bonanza King, at Trinity Center; the Oro Grande, at Carrville; the Bully Choop (Ono P. O.), and the Globe, at Dedrick. Smaller quartz producers are the Quimby, at Burnt Ranch; Blue Jay, at Carrville; Enterprise, at Coleridge; Lappin and Vermont, at Deadwood; and Chloride-Bailey, at Dedrick. There are several others producing less than $5,000 each.

YUBA COUNTY.

Yuba has 6 deep mines which produced 1,651 more tons of ore than in 1904, but of a much lower grade. The total gold from these deep mines amounted to $17,839. The placer mines number 34, of which 26 are surface placers, 5 hydraulic mines, 2 drift, and 1 is really a dredge company owning several dredges. A very large proportion of the gold came from this latter source. A new dredging field has been opened along the Yuba River, and several dredges of the largest size have been built. Only one was producing in 1905, the others not having been completed at that time.

The gravel is much deeper in this field than at Oroville or Folsom, and is more easily and cheaply worked. For this reason some of the dredge miners have sold out at Oroville and have invested in the Yuba River field. A large amount of available dredging ground has been purchased by the principal company, and a town has been established near the scene of operations, where facilities for repairs to the machines have been provided. It is predicted by many that this will eventually be the most important dredging field in the State. The machines are made to dig 62 feet below water level, and are of very large daily capacity. They are immensely strong and cost about double what dredges of ordinary size did a few years ago. The county produced $138,760 more gold than in 1904, which is mainly due to the dredging operations recently inaugurated.

OTHER COUNTIES.

Alpine County has only one producing deep mine and no placers. Other mines are being opened, however, and some copper discoveries have recently been made. Lassen and Los Angeles counties, though widely separated geographically, are grouped to avoid disclosing certain individual operations. There are only 5 producing mines in the 2 counties, 4 deep mines, and one surface placer. The combined counties yielded $157,100, of which $154,984 was gold and the balance silver, no copper or lead being produced. Both Mendocino and Modoc show nominal yields of gold, there being only one small producer in each county. In Monterey there are 2 productive mines, 1 deep mine and one surface placer. Riverside County only shows an output of $5,937 gold, and $55 silver from 3 mines reporting product. Santa Barbara only reports a small product from ocean beach sands from one locality. Stanislaus yielded $50,000 gold and $500 silver, from 1 deep mine. The yield of Tulare county was only $4,323 from 3 deep mines. The "undistributed" silver, amounting to $100,000 was silver from different counties of the State, which was received at mints and refineries, but not traced to actual source by individual mine. This is due to the fact that many gold mines report gold output, and make no account of the silver content.

COLORADO.

By Waldemar Lindgren.

PRODUCTION.

The gold production of Colorado for 1905, as reported by the producers, amounted to 1,210,534.73 fine ounces, corresponding to $25,023,973, and indicates an increase of $560,651 over 1904.

Of silver, 11,499,307 fine ounces were reported, equivalent to $6,945,581, which is a decrease of 2,448,328 ounces from the quantity reported in 1904. In value the decrease amounts to $1,039,447.

The returns were received from 513 mines, of which 23 were placers. The 490 deep mines yielded 2,504,087 short tons of ore having an average value of $12.73 in gold and silver, compared with $13.84 in 1904; the total average value, counting base metals at New York prices, was $17.37, against $17.89 in 1904. The total yield of gold, silver, copper, lead, and zinc at New York average prices in 1905, was $43,587,081, an increase of $1,674,017 over the figures for 1904.

The output of lead and zinc has been greatly stimulated, but somewhat less copper was produced in 1905 than in 1904, in spite of the higher price of the metal in 1905.

Production of gold, silver, and associated metals in Colorado in 1904 and 1905.

	1904.		1905.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold....fine ounces..	1,183,517.78	[a]$24,463,322	1,210,534.73	[a]$25,023,973	+27,016.95	+ $560,651
Silver..........do....	13,947,635	7,985,028	11,499,307	6,945,581	−2,448,328	−1,039,447
Copper .....pounds..	9,435,962	1,179,402	9,404,830	1,467,153	− 31,132	+ 287,751
Lead..........do....	102,792,782	4,497,183	111,585,060	5,244,498	+8,792,278	+ 747,315
Zinc ....do....	75,762,580	3,788,129	83,150,445	4,905,876	+7,387,865	+1,117,747
Total..........	....	41,913,064	... .	43,587,081	....	+1,674,017

[a] Gold value calculated at $20.67 per fine ounce in 1904, at $20.671834 per fine ounce in 1905.

Production of gold, silver, copper, lead, and zinc in Colorado in 1905, by counties.

County.	Producing mines.	Tonnage.	Gold.		Silver.	
			Quantity.	Value.	Quantity.	Value.
		Short tons.	*Fine ounces.*		*Fine ounces.*	
Boulder..............	31	9,577	12,654.92	$261,601	70,921	$42,836
Chaffee	15	13,408	1,566.28	32,378	75,265	45,460
Clear Creek	49	58,775	24,366.42	503,698	692,437	418,232
Conejos	([a])	([a])	140.00	2,894	900	544
Custer................	[b]5	[b]4,567	1,205.43	24,918	32,159	19,424
Dolores	5	3,826	1,681.81	34,766	76,526	46,222
Eagle	9	12,049	2,268.34	46,891	46,487	28,078
Gilpin................	66	182,873	70,145.33	1,450,033	340,901	205,904
Grand.................	1	12	1.50	31	22	13
Gunnison	18	5,581	1,362.05	28,156	53,649	32,404
Hinsdale..............	10	5,041	580.07	11,991	54,419	32,869
Jefferson	4	15	([c])	([c])	125	76
Lake..................	61	648,464	57,101.87	1,180,401	4,033,762	2,436,392
La Plata	4	5,662	12,187.61	251,940	93,258	56,328
Mineral...............	10	91,338	8,812.09	182,162	814,189	491,770
Ouray.................	14	98,966	112,872.52	2,333,282	306,406	185,069
Park	19	6,745	[d]24,014.84	[d]496,431	49,202	29,718
Pitkin................	25	107,927	12.00	248	2,469,520	1,491,590
Routt	2	....	334.03	6,905	30	18
Saguache	4	496	33.82	699	4,401	2,658
San Juan..............	20	204,139	50,840.74	1,050,971	750,841	453,510
San Miguel	19	291,338	82,810.89	1,711,853	1,275,079	770,148
Summit................	34	36,930	([c])	([c])	209,356	126,451
Teller................	88	716,358	745,542.17	15,411,724	49,449	29,867
Total..........	513	2,504,087	1,210,534.73	25,023,973	11,499,307	6,945,581

County.	Copper.		Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Pounds.*		
Boulder	2,227	$347	....	....	....	....	$304,784
Chaffee...............	379,722	59,237	1,250,302	$58,764	315,495	$18,614	214,453
Clear Creek...........	235,669	36,764	3,270,211	153,700	1,869,995	110,330	1,222,724
Conejos...............	....	....	....	....	....	....	3,438
Custer	2,500	390	....	....	....	....	44,732
Dolores...............	119,821	18,692	840,319	39,495	1,500,000	88,500	227,675
Eagle.................	29,331	4,576	156,723	7,366	2,915,025	171,986	258,897
Gilpin	512,276	79,915	519,841	24,433	191,574	11,303	1,771,588

[a] Included in Custer County.
[b] Including Conejos County.
[c] Gold products of Jefferson and Summit counties included with Park County.
[d] Including gold products of Jefferson and Summit counties.

Production of gold, silver, copper, lead, and zinc in Colorado in 1905, etc.—Continued.

County.	Copper.		Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Pounds.*		
Grand	1,680	$262	....	....	....	....	$306
Gunnison	50,500	7,878	219,809	$10,331	101,559	$5,992	84,761
Hinsdale	84,485	13,180	767,681	36,081	2,085	123	94,244
Jefferson	9,000	1,404	....	....	....	....	a 1,480
Lake	3,105,710	484,491	51,162,040	2,404,616	64,856,033	3,826,506	10,332,406
La Plata	2,923	456	....	....	....	....	308,724
Mineral	....	....	10,576,146	497,079	2,513,457	148,294	1,319,305
Ouray	52,333	8,164	2,491,808	117,115	48,267	2,848	2,646,478
Park	12,199	1,903	543,303	25,535	....	....	b 553,587
Pitkin	41,276	6,439	22,386,142	1,052,149	5,268,091	310,817	2,861,243
Routt	....	....	....	....	....	....	6,923
Saguache	1,135	177	203,797	9,578	....	....	13,112
San Juan	1,675,858	261,434	8,045,126	378,121	248,627	14,669	2,158,705
San Miguel	17,721	2,764	6,970,152	327,597	....	....	2,812,362
Summit	....	....	2,181,660	102,538	3,320,237	195,894	a 424,883
Teller	....	....	....	....	....	....	15,441,591
Unapportioned	3,068,464	478,680	....	....	....	....	478,680
Total	9,404,830	1,467,153	111,585,060	5,244,498	83,150,445	4,905,876	43,587,081

a Gold products of Jefferson and Summit counties included with Park County.
b Including gold products of Jefferson and Summit counties.

Increase (+) or decrease (—) in production of gold and silver in Colorado in 1905, as compared with 1904, by counties.

[Fine ounces.]

County.	Gold.		Silver.	
	Quantity.	Value.	Quantity.	Value.
Boulder	— 6,139.36	—$126,881	— 26,307	— $12,829
Chaffee	— 1,811.58	— 37,440	+ 25,391	+ 16,905
Clear Creek	— 7,828.00	— 161,761	— 43,548	— 3,119
Conejos	+ 140.00	+ 2,894	+ 900	+ 544
Custer	— 1,971.94	— 40,757	— 78,208	— 43,761
Dolores	— 320.62	— 6,625	— 23,668	— 11,136
Eagle	+ 794.71	+ 16,431	+ 25,476	+ 16,050
Gilpin	+16,694.30	+ 345,200	— 14,453	+ 2,464
Grand	+ 1.50	+ 31	+ 22	+ 13
Gunnison	— 27.48	— 564	— 74,447	— 40,931
Hinsdale	+ 208.07	+ 4,299	+ 15,136	+ 10,381
Jefferson	(a)	(a)	+ 100	+ 62
Lake	+ 215.57	+ 4,560	— 786,834	— 323,400
La Plata	+ 6,906.95	+ 142,789	+ 61,688	+ 38,255
Mineral	— 2,096.84	— 43,325	— 852,120	— 462,191
Ouray	+ 7,678.49	+ 158,921	+ 42,021	+ 33,709
Park	+ b 4,824.84	+ b 99,770	— 7,862	— 2,952
Pitkin	— 35.00	— 723	+ 319,485	+ 260,695
Routt	+ 334.03	+ 6,905	+ 30	+ 18
Saguache	— 384.18	— 7,942	— 42,832	— 24,383
San Juan	—33,156.81	— 685,258	— 834,094	— 453,877
San Miguel	— 829.06	— 16,985	— 54,105	+ 9,190
Summit	(a)	(a)	— 82,793	— 40,804
Teller	+43,832.06	+ 907,374	— 17,189	— 8,283
Larimer and Mesa	— 12.70	— 262	— 117	— 67
Total	+27,016.95	+ 560,651	—2,448,328	—1,039,447

a Included in Park County. b Including Jefferson and Summit counties.

The mining industry of the State is in a flourishing condition, as shown, among other things, by the fact that 170,221 more tons were mined in 1905 than in 1904. A somewhat lower grade of ore could be mined on account of lessened cost of mining and smelting. The leasing system, already so prevalent in Colorado, is still further extended in nearly all of the important camps. Another feature is the continued extension of electric power lines in many mining districts.

Tonnage of ore sold or treated, number of producing mines, and tenor of ores in 1904 and 1905.

County.	Total tons of ore sold or treated.		Number of mines producing (with placers).		Average total value per ton.		Average value per ton in gold and silver.	
	1905.	Increase(+) or decrease (−).	1904.	1905.	1904.	1905.	1904.	1905.
	Short tons.	*Short tons.*						
Boulder	9,577	− 14,328	52	31	$18.51	$31.81	$18.48	$31.78
Chaffee	13,408	+ 631	14	15	13.74	14.87	7.70	4.68
Clear Creek	58,775	− 3,886	53	49	22.37	20.77	17.31	15.65
Conejos	(a)	(a)	....	(a)	....	(a)	....	(a)
Custer	b 4,567	− b 5,603	7	b 5	12.80	b 10.55	12.67	b 10.46
Dolores	3,826	− 3,901	10	5	15.39	59.51	16.68	21.17
Eagle	12,049	+ 10,183	10	9	32.26	21.47	22.77	6.21
Gilpin	182,873	+ 73,316	55	66	12.73	9.69	11.94	9.05
Grand	12	+ 12	....	1	....	25.50	....	3.67
Gunnison	5,581	+ 3,514	15	18	49.58	15.19	49.05	10.85
Hinsdale	5,041	− 550	11	10	14.79	18.70	5.38	8.90
Jefferson	(c)	(c)	1	4	....	93.60	....	....
Lake	648,464	− 15,023	66	61	17.14	15.93	5.93	5.58
La Plata	5,662	+ 1,870	12	4	33.63	54.53	33.55	54.45
Mineral	91,338	− 32,940	10	10	13.77	14.44	9.49	7.38
Ouray	98,966	+ 7,722	12	14	26.93	26.74	25.49	25.45
Park	d 43,690	+ d 4,013	12	19	55.76	55.63	53.31	51.56
Pitkin	107,927	− 1,843	36	25	14.89	26.51	11.22	13.82
Routt	....	....	....	2	....	....	....	....
Saguache	496	− 3	5	4	86.98	26.44	71.51	6.77
San Juan	204,139	− 29,524	31	20	15.45	10.57	11.31	7.37
San Miguel	291,338	+ 58,022	25	19	11.77	9.58	10.48	8.45
Summit	(c)	(c)	37	34	18.20	14.85	7.77	6.77
Teller	716,358	+118,539	102	88	24.33	21.56	24.33	21.56
Larimer and Mesa	....	− 15	2	....	....	....	....	....
Total	2,504,087	+170,221	578	513	17.89	17.37	13.84	12.73

a Included in Custer County.
b Including Conejos County.
c Included in Park County.
d Including Jefferson and Summit counties.

Number of mines in Colorado, classified by chief products, in 1905.

County.	Gold placer mines.			Deep mines.								Total mines producing.
	Hydraulic.	Surface.	Dredge.	Gold.	Silver.	Gold and silver.	Gold, silver, copper.	Gold, silver, copper, lead.	Gold, silver, lead.	Silver, lead.	Silver, lead, zinc.	
Boulder	......	1	......	14	1	12	3	......	......	......	......	31
Chaffee	1	......	......	1	......	2	5	1	3	......	2	15
Clear Creek	......	3	......	3	1	11	9	1	12	2	7	49
Conejos	......	......	......	......	......	(a)	......	......	......	......	......	(a)
Custer	......	......	......	......	2	b 3	......	......	......	......	......	b 5
Dolores	......	......	......	......	......	1	1	......	2	......	1	5
Eagle	......	1	......	1	......	1	3	......	......	2	1	9
Gilpin	......	1	......	9	......	30	20	1	5	......	......	66
Grand	......	......	......	......	......	......	1	......	......	......	......	1
Gunnison	......	......	......	5	......	6	2	......	3	......	2	18
Hinsdale	......	......	......	......	......	2	......	4	4	......	......	10
Jefferson	......	......	2	......	......	......	c 2	......	......	......	......	4
Lake	......	......	......	2	9	12	2	5	14	12	5	61
La Plata	......	......	......	......	......	3	1	......	......	......	......	4
Mineral	......	......	......	......	4	......	......	......	5	......	1	10
Ouray	......	......	......	......	......	6	4	1	2	......	1	14
Park	3	2	......	1	4	1	2	......	4	2	......	19
Pitkin	......	......	......	......	6	......	......	......	......	13	6	25
Routt	......	2	......	......	......	......	......	......	......	......	......	2
Saguache	......	......	......	......	......	......	......	1	3	......	......	4
San Juan	......	......	......	2	......	5	3	4	2	3	1	20
San Miguel	1	......	......	1	......	7	2	1	6	1	......	19
Summit	5	......	1	1	2	6	......	......	10	2	7	34
Teller	......	......	......	88	......	......	......	......	......	......	......	88
Total	10	10	3	128	29	108	60	19	75	37	34	513

a Included in Custer County. b Including Conejos County. c Two copper mines.

The gold-mining industry shows a satisfactory advance, which is chiefly due to Gilpin and Teller (Cripple Creek) counties. Twenty-four counties reported production, the more important being, in order of value, Teller, Ouray, San Miguel, Gilpin, Lake, and San Juan, all of which exceeded the million-dollar mark. The largest increases took place in Teller, Gilpin, Ouray, and La Plata, while in the eleven counties which showed a decrease the greatest diminution was in San Juan, Clear Creek, and Boulder. The placers were worked in Park, Summit, Jefferson, Chaffee, Boulder, Clear Creek, Routt, Eagle, San Miguel, and Gilpin counties, mostly by hydraulic sluicing of low banks. Two dredges were worked in Jefferson and one in Summit County. As a rule there is little ground available for this kind of mining on account of the great number of large boulders usually present in the stream beds. The yield of gold from placer mines was 4,855.71 ounces, a decrease of 2,166.29 ounces compared with 1904. The bulk of the gold, or 1,165,232.96 ounces, is derived from dry or quartzose ores from Teller, Gilpin, Lake, and Clear Creek counties, and from the San Juan region. Only 3,884.13 ounces are derived from copper ores, with over 4 per cent of copper. Such ores came chiefly from Gilpin, but also from Chaffee, Clear Creek, and Ouray counties. Practically no copper ores, properly speaking, came from Lake County, although this is one of the principal producers of this metal. Gold from lead ores amounted to 31,667.99 ounces, against 70,641 in 1904; these ores came from Mineral, San Juan, Ouray, and Lake counties. Gold from zinc and zinc-lead ores amounted to 4,893.94 ounces, against 4,697 in 1904, and practically the whole amount is derived from Leadville and from Summit County.

With the exception of some gold from Leadville and other scattered localities, almost the whole production is obtained from fissure veins of Tertiary age. From Clear Creek, Gilpin, and Boulder counties were obtained $2,215,332, against $2,158,774 in 1904; from Leadville, $1,180,401, against $1,175,841 in 1904; from Cripple Creek, $15,411,724, against $14,504,350 in 1904, and finally from the San Juan region, comprising San Juan, San Miguel, Ouray, Dolores, Hinsdale, and La Plata counties, $5,394,803, against $5,797,662 in 1904.

Source of gold product in Colorado by kinds of ore in 1905, by counties.

[Fine ounces.]

County.	Placers.	Deep mines.					Total.
		Dry or siliceous ores.	Copper ores.	Lead ores.	Zinc ores.	Lead-zinc ores.	
Boulder	4.83	12,650.09					12,654.92
Chaffee	726.07	73.38	349.49	417.34			1,566.28
Clear Creek	91.00	21,944.25	420.48	1,779.61		131.08	24,366.42
Conejos		140.00					140.00
Custer		1,200.43	5.00				1,205.43
Dolores		1,476.22	12.05	68.54		125.00	1,681.81
Eagle	7.60	2,176.86	2.00		81.88		2,268.34
Gilpin	6.53	66,763.11	2,762.73	612.96			70,145.33
Grand			1.50				1.50
Gunnison		964.13	7.93	384.77	5.22		1,362.05
Hinsdale		363.83	7.23	209.01			580.07
Jefferson [a]							
Lake		50,909.47		4,043.11	1,759.29	390.00	57,101.87
La Plata		12,187.61					12,187.61
Mineral		395.14		8,416.95			8,812.09
Ouray		107,835.55	312.18	4,724.79			112,872.52
Park [b]	2,641.36	18,600.25		371.76		2,401.47	24,014.84
Pitkin				12.00			12.00
Routt	334.03						334.03
Saguache		33.52		.30			33.82
San Juan		42,679.14	3.54	8,158.06			50,840.74
San Miguel		79,297.81		2,468.79			81,766.60
Summit [a]							
Teller		745,542.17					745,542.17
Unapportioned	1,044.29						1,044.29
Total	4,855.71	1,165,232.96	3,884.13	31,667.99	1,846.39	3,047.55	1,210,534.73

[a] Included under Park County.
[b] Includes Jefferson and Summit counties.

Silver shows the very marked decrease of 2,448,328 ounces, as compared with the output for 1904; in value, also, it decreased $1,039,447. This makes Colorado the second of the silver-producing States, Montana now taking the lead. Increases were noted in Pitkin, La Plata, Ouray, Chaffee, Eagle, Hinsdale, Conejos, and Grande; but large decreases occurred in many of the other counties, principally in San Juan, Mineral, and Lake counties. It appears remarkable that this lessened silver production should be accompanied by an increased yield of lead, since the two metals usually keep company, and a more detailed analysis may be worth while. In San Juan County, where silver decreased 834,094 fine ounces, lead also decreased more than 2,000,000 pounds. In Mineral, silver decreased 852,120 ounces, but lead increased over 1,000,000 pounds. This is due to the treatment of large quantities of lead-zinc ores low in silver value. In Lake County silver decreased 786,834 ounces, and lead likewise by over 3,000,000 pounds. In Pitkin County (Aspen) silver increased 319,485 ounces, and lead likewise increased greatly, though it should be stated that the lead production of Aspen was probably given too low in the report for 1904. In a great number of the smaller counties a consistent increase appears in the output of lead, which is not accompanied by a corresponding rise in the silver values. In Gilpin, for instance, the output of lead rose from 125,731 pounds in 1904 to 519,841 pounds in 1905, while silver actually decreased 14,453 ounces. On the whole, the greater activity in the mining of lead-zinc ores low in silver seems responsible for this anomaly.

The more important silver-producing counties rank as follows: Lake, Pitkin, and San Miguel, which all yielded over 1,000,000 ounces; Mineral, San Juan, Clear Creek, Ouray, and Gilpin, which all yielded over 300,000 ounces.

The greatest quantity of silver was obtained from dry or siliceous ores [the majority of the Leadville ores are classed as such]. Lead ores proper, containing over 5 per cent lead, yielded 3,883,827 ounces of silver, against 4,427,985 ounces in 1904. In view of the increased output of lead in 1905, this again shows the importance gained by the dry ores low in lead and silver. In 1904 the zinc and zinc-lead ores yielded 2,004,918 ounces of silver, and this decreased to 1,451,625 ounces in 1905. The silver in Colorado is partly obtained from fissure veins, partly from irregular or flat replacement deposits in limestone. All of the important deposits are believed to be of Tertiary age. The fissure veins of Clear Creek, Boulder, and Gilpin counties produced 1,104,259 ounces in 1905, against 1,188,567 ounces in 1904. The fissure veins of the San Juan region, embracing San Juan, San Miguel, Ouray, Dolores, Hinsdale, and La Plata counties, produced 2,556,532 ounces, against 3,349, 554 ounces in 1904. The increase in the replacement deposits at Aspen and the decrease in the Leadville deposits have already been mentioned.

The great increase in the price of silver should stimulate the production in 1906. A larger tonnage is already reported from Leadville, and the mining of dry silver ores (containing little or no gold, lead, and copper), which now has fallen to a low ebb, will probably be revived.

Source of silver product in Colorado by kinds of ore in 1905, by counties.

[Fine ounces.]

County.	Placers.	Deep mines.					Total.
		Dry or siliceous ores.	Copper ores.	Lead ores.	Zinc ores.	Lead-zinc ores.	
Boulder	2	70,919					70,921
Chaffee	131	5,035	23,586	29,912	3,595	13,006	75,265
Clear Creek	45	348,019	3,361	280,177		60,835	692,437
Conejos		900					900
Custer		32,059	100				32,159
Dolores		47,030	4,708	7,288		17,500	76,526
Eagle	2	42,487	80	783	3,135		46,487
Gilpin	3	322,609	13,992	4,297			340,901
Grand			22				22
Gunnison		37,046	1,060	13,780	1,763		53,649
Hinsdale		7,567	1,169	45,683			54,419
Jefferson[a]							
Lake		2,244,343		954,999	488,954	345,466	4,033,762
La Plata		93,258					93,258
Mineral		745,172		69,017			814,189

[a] Included under Park County.

Source of silver product in Colorado by kinds of ore in 1905, by counties—Continued.

County.	Placers.	Deep mines.					Total.
		Dry or siliceous ores.	Copper ores.	Lead ores.	Zinc ores.	Lead-zinc ores.	
Ouray		158,048	3,530	144,828			306,406
Park [a]	695	144,547	2,400	9,614	3,000	98,427	258,683
Pitkin		401,663		1,651,913	415,944		2,469,520
Routt	30						30
Saguache		35		4,366			4,401
San Juan		263,138	1,380	486,326			750,844
San Miguel		1,094,235		180,844			1,275,079
Summit [b]							
Teller		49,449					49,449
Total	908	6,107,559	55,388	3,883,827	916,391	535,234	11,499,307

[a] Includes Jefferson and Summit counties.
[b] Included under Park County.

The lead industry has already been considered in connection with the silver. The total production increased from 102,792,782 pounds in 1904 to 111,585,060 pounds in 1905, the leading counties being, in their order, Lake, Pitkin, Mineral, San Juan, San Miguel, Clear Creek, Ouray, Summit, and Chaffee, all of which yielded over 1,000,000 pounds.

A notable percentage of the lead in the ores does not reach a metallic state, but is utilized for zinc-lead pigment in the Pueblo plant.

There is naturally a certain quantity of lead which is not obtainable by the method of collecting statistics used for these reports; that is the metal which is contained in concentrates and shipping ores in quantities less than 4 or 5 per cent. The smelting companies receive the benefit of this lead contained in these ores, but no mention is, as a rule, made of it in the cards received from the producers. It is not probable that this quantity makes a large percentage in Colorado. The chief source of such lead would probably be found in Gilpin and Clear Creek counties, as well as in the San Juan region. Practically no ore is shipped to lead smelters from Leadville, Aspen, and Creede in which the percentage of lead is not paid for.

Colorado produces but little copper; no large copper mine is located within its boundaries. The output has shown but little variation and is taken to be 9,404,830 pounds in 1905. Lake County contributed 3,105,710 pounds and San Juan followed with 1,675,858 pounds. From Gilpin, Chaffee, Clear Creek, and Dolores, outputs were recorded ranging from 119,821 to 512,276 pounds, the latter figure being furnished by Gilpin County.

It has proved impossible to obtain more than 6,336,366 pounds by inquiries from the producers, while it is positively known by smelter returns that much more than this was actually produced. For this reason the figures of Mr. Kirchhoff obtained from smelter statistics in 1905 have been adopted, and the inference is that the difference, or 3,068,464 pounds, has been chiefly obtained from ores in which copper occurred in such small quantities (that is, below 2 per cent or $1\frac{1}{2}$ per cent) that no payment was made for the metal. Some of this difference doubtless should be credited to Gilpin County concentrates, another part to Leadville ores, and a third part to concentrates from the San Juan region.

The production of zinc in 1905 is estimated at 83,150,445 pounds of spelter, valued at $4,905,876, against 75,762,580 pounds or $3,738,129 in 1904. In the report for 1904 the assay value of the zinc ores was recorded as the production, but, as is well known, a very great loss takes place in zinc smelting, and it is necessary to subtract a corresponding amount. The loss on an average 32 per cent zinc ore may be estimated as 25 per cent, and on this basis the quantities and values of the figures for 1904 have been corrected. There is undoubtedly much more uncertainty in the figures for the zinc production than in those of the other metals. Besides, a large quantity of the ore is used for the manufacture of paint and does not appear as spelter, although in the figures given the whole of the ore is assumed to have yielded metallic zinc. The zinc ores of Colorado are so variable in tenor and value, on account of other metals admixed, that an estimate by tonnage, such as is usual in the Missouri River valley, is scarcely practicable. The treatment of the ores is also complicated. Some are shipped crude, while other ores are subjected to one wet and one dry concentration, the latter usually by electrostatic or electromagnetic machines. The zinc ores of Colorado contain very little gold, and are, as a rule, low in silver; the latter metal is, however, usually recovered from the cinders after the distillation of the zinc. The greatest production came from Leadville, from which 64,856,033 pounds were reported. Pitkin County (Aspen) yielded over 5,000,000 pounds; Summit and Eagle counties about 3,000,000 pounds each; Mineral, about 2,500,000 pounds; Clear Creek, nearly 2,000,000 pounds; Dolores, 1,500,000 pounds. Six other counties yielded less than 1,000,000 pounds each.

A future increase in the zinc production of Colorado is probable as further technical improvements are introduced into the industry.

Colorado is one of the large smelting States, and a great deal of ore from other States is shipped to Colorado plants. The lead smelters are unable to obtain a sufficient quantity of lead ores, and a very large quantity of concentrates from northern Idaho are shipped into the State annually.

The following list gives the smelting plants in Colorado in 1905:

List of Colorado smelting plants in 1905.

City.	Plant.	Owner.
Denver	Globe	American Smelting and Refining Co.
Pueblo	Pueblo	Do.
Do	Eilers	Do.
Do.[a]	United States Zinc Co.	Do.
Leadville	Arkansas Valley	Do.
Durango	Durango	Do.
Denver	Argo	Boston and Colorado Smelting and Refining Co.
Canyon City [a]		United States Smelting Co.
Salida		Ohio and Colorado Smelting and Refining Co.
Silverton[b]		Kendrick & Gelder.
Grand Junction[b]		
Pearl [b]		National Mining and Milling Co.

[a] Zinc ores. [b] Pyritic smelting.

The majority of the mineral deposits of Colorado are contained in a belt extending across the State from northeast to southwest, but not reaching the borders in either direction. Beginning in Boulder, Gilpin, and Clear Creek counties, a short distance northwest of Denver, it continues through Summit, Park, Lake, Eagle, Pitkin, Chaffee, and Gunnison counties down to the San Juan country, in which Ouray, San Miguel, Dolores, San Juan, La Plata, Hinsdale, and Mineral counties are productive. There probably are some very old pre-Cambrian deposits, chiefly low-grade copper ores, scattered through granite and schists of the Park and Sangre de Cristo ranges from Wyoming to New Mexico; but practically all of the productive mines of the belt referred to are believed to be of Tertiary age and are connected with the occurrence of a series of intrusive dikes, sheets, or masses of diorite or granitic porphyries, which have been forced into the old granites and schists, as in the Gilpin and Clear Creek districts, or into the sedimentary Carboniferous limestones, as in Pitkin or Lake counties, or finally into Tertiary lava flows, as in the San Juan country.

The great Park and the Sangre de Cristo ranges are generally barren except when crossed by the belt of igneous activity. There are, however, several isolated points outside of this belt where mineral deposits occur. The most important of these is Cripple Creek, in Teller County, where the barrenness of the granitic Front Range is relieved by the occurrence of the richest gold camp in the United States. The space that the mines occupy would hardly be visible in an ordinary State map, and the whole of the sum of over $150,000,000 that has been extracted came from the breccia and intrusive masses filling a volcanic explosion crater a few miles in diameter.

Another small center of mineralization is located at Silver Cliff, in Custer County, and is connected with eruptions of rhyolite. A third isolated district is at Hahns Peak, in Routt County, where an intrusion of porphyry into the old granites and schists has been followed by mineralization.

And so throughout the State the dependence of the ore deposits on the intrusions of mother masses into older rocks is a most striking fact, and one which the prospectors of Colorado have not failed to recognize.

PRODUCTION BY INDIVIDUAL COUNTIES.

BOULDER COUNTY.

The gold production of Boulder County in 1905 was $261,601, a decrease of $126,881 as compared with 1904. Of silver 70,921 ounces were reported, a decrease of 26,307 ounces from the figures of 1904. An insignificant quantity of copper but no lead or zinc were reported. The production was reported from 31 mines, of which one was a placer mine, as compared with 52 mines in 1904. These 31 mines had a total tonnage of 9,577 tons, a decrease of 14,328 tons from 1904. The decrease in gold and silver was, however, more than compensated by a large output of tungsten ore, chiefly from the Nederland district, believed to have amounted to a value of $350,000.

The county is characterized by a great number of usually narrow gold or gold-silver veins contained in granite and schist, and usually accompanied by porphyry dikes. The prevailing strike, coincident with the general direction of the mineral belt, is northeast-southwest, although many of the veins have a course perpendicular to this. Many of the mines are worked on a small and intermittent plan. The ores are ordinarily of a smelting grade—very siliceous—and many of them contain tellurides. A smaller quantity is partly free milling and is best treated by this process, followed by concentration and cyaniding. The average grade in 1905 was high—$31.81 per ton against $18.51 in 1904.

Much development work was in progress and the yields for 1906 and 1907 are likely to be greater than that of 1905. Comparatively few of the mines are opened by long tunnels or by shafts over 700 feet deep.

Central district.—The county is divided into seven or eight mining districts. The Central district is located near Jamestown and Springdale, near the center of the county. Among the producers were the Red Spruce, Rip van Dam, Smuggler, and Wano mines, the latter the property of the Monarch Consolidated Company, which is reported to be erecting a 50-ton cyanide mill with roasting furnaces.

Gold Hill district.—A few miles south of this is the Gold Hill district, which for present purposes may be said to include the mines near Salina, Wall Street, Sunshine, and Rowena. The Emancipation, Fairfax, Ingram, Cash, and American Queen mines are worked in this vicinity. The latter two, which are among the larger producers in the county, are owned by the American Queen Gold Mining Company. A concentrating mill was erected in 1905.

Ward district.—In the Ward district, 5 miles east of Gold Hill, mining matters were rather quiet in 1905. Production was reported from the Dew Drop, Columbia, and Ni Wot properties, since consolidated as the Big Five Company.

Sugar Loaf district.—The Sugar Loaf district is situated a few miles south of Gold Hill, on the divide between Four Mile Creek and Boulder Creek. Here are located the Logan mine of the Clinton Mining and Milling Company, which is opened by four tunnels, and the Livingston mine, developed by shafts, both of which are among the important producers of the county.

Caribou and Grand Island districts.—In the southwestern corner of the county are the Caribou and the Grand Island districts. There was practically no output from the former, while in the latter the Mogul tunnel, at Eldora, and the Bird's Nest mine reported production. Extensive development work by tunnels was carried on in the old Boulder County mine. The famous old Caribou silver mine was idle.

CHAFFEE COUNTY.

Metallic production of Chaffee County, Colo., in 1904 and 1905.

Year.	Gold.		Silver.		Copper.		Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine oz.		*Fine oz.*		*Pounds.*		*Pounds.*		*Pounds.*		
1904..	3,377.86	$69,818	49,874	$28,555	456,556	$57,069	458,422	$20,055	....	....	$175,497
1905..	1,566.28	32,378	75,265	45,460	379,722	59,237	1,250,302	58,764	315,495	$18,614	214,453

Fifteen mines were operated, against 14 in 1904. The deep mines yielded 13,408 short tons and a total average value of $14.87 per ton. The average value of the gold and silver per ton was $4.68.

For many years Chaffee County has maintained a moderate production of metals from seven or eight mining districts and from many different kinds of ore.

The county is situated in the center of the State, south of Lake (Leadville) and east of Gunnison. The mining districts are situated on both sides of the Arkansas River, which traverses the county from north to south. The year 1905 shows a somewhat decreased gold and copper production, while silver and lead have increased, and zinc has been added to the metallic product.

Very little information is available as to the geological features of the Chaffee County mines.

Placer mining by the hydraulic method was carried on near the old mining district of Granite, close to the Lake County line, the Arlington Gold Mining Company being the principal operator. Some gold-smelting ores were also produced in this vicinity.

Winfield district.—The Winfield district, 15 miles west of Granite, shipped small quantities of smelting ores, chiefly carrying silver.

Cottonwood and Alpine districts.—Development work only was reported from the Cottonwood district, east of Buena Vista, and from the Alpine district on Chalk Creek, 15 miles southwest of Buena Vista, in which the veins are reported to occur in granite and schist.

Monarch district.—Active production is reported from the Monarch district (including Garfield) 15 miles due west of Salida, where silver-lead ores with some gold and copper are said to occur between limestone and porphyry. The well-known Madonna mine, a steady producer of silver-lead ore, is located here; it is developed by several adit tunnels. Among the other producers are the Garfield, Fairview, Fairplay, Flossie D., and Monarch mines. The total production of this district is almost half of that of the county.

Turret district.—The Turret district is situated 6 miles northeast of Salida near the Fremont County line, and produced well, chiefly of copper ores carrying gold and silver. The Sedalia copper mine, which is equipped with a leaching plant, is located here and was in active operation.

CLEAR CREEK COUNTY.

Metallic production of Clear Creek County, Colo., in 1904 and 1905.

Year.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*		*Pounds.*	
1904	32,194.42	$665,459	735,985	$421,351	369,778	$46,222
1905	24,366.42	503,698	692,437	418,232	235,669	36,764

Year.	Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
1904	3,753,447	$164,213	1,601,477	$80,074	$1,377,319
1905	3,270,211	153,700	1,869,995	110,330	1,222,724

A moderate decline in the output of all metals except zinc is noted in 1905, but in all probability there will be a decided increase in the total production for 1906, as very important development work is going on in all parts of the county. Forty-nine mines were in operation and yielded a total of 58,775 tons, a decrease of about 4,000 tons as compared with 1904. The Clear Creek ores are of rather high grade, averaging $20 per ton in all metals, and $15.65 in gold and silver.

Clear Creek County adjoins Gilpin on the southwest. The principal part of the county has recently been mapped by the Geological Survey, and the Georgetown Folio is in press. Short descriptions of Georgetown and Idaho Springs districts are published in Bulletins 260 and 285, by Mr. J. E. Spurr.

The deposits are fissure veins in granite and gneiss, and are often accompanied by dikes of granitic or felsitic porphyries. The general strike of the vein system is northeasterly. The ore consists of gold and silver bearing sulphides, which also yield much lead and zinc.

Idaho district.—The county is divided into several not very closely defined mining districts. For present purposes, the Idaho district may include the mines at Idaho Springs, as well as the subdistricts of Banner, Coral, Jackson, Montana, Payne Bar, Spanish Bar, Virginia, Upper Union, and Trail Creek. The ores of the Idaho district contain principally gold, with smaller quantities of copper and silver, as well as some lead.

Telluride ores, which are not common in the county, have recently been met in the lower workings of the Consolidated Gem mines. The latter mines, as well as the Sun and Moon, are drained by the Newhouse tunnel. The Saratoga vein is also opened by the same tunnel, but the upper workings are not drained.

Among other important producers are the Specie Payment, the Treasure Vault, and the Mattie group. At Trail Creek the Brighton, the Champion, and the New Era are among the producers.

Silver ores, with some gold, were shipped by the Lamartine mine, which is developed by a vertical shaft 900 feet deep.

Though much of the ore is shipped direct to the smelters through sampling works, there are about 12 concentrating mills at Idaho Springs, among them those of the

Gem, the Waltham custom mill (with cyanide attachment), the Hawley, and others. A few of them amalgamate before concentrating.

South of Idaho Springs the McClelland tunnel, now reported 5,000 feet in length, is driving to intersect the veins of the Freeland system.

Metallic production of Idaho district, Clear Creek County, Colo., in 1905.

Year.	Gold.		Silver.		Copper.		Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine oz.		*Fine oz.*		*Pounds.*		*Pounds.*		*Pounds.*		
1905.....	22,476.31	$464,626	340,741	$205,808	207,361	$32,348	480,699	$22,593	144,960	$8,553	$733,928

Empire district.—Only a small production is reported from Empire, between Idaho Springs and Georgetown, where a 3,000-foot tunnel has been driven recently to intersect the veins of the district, which are principally gold bearing.

Lincoln district.—Little activity is reported from the Lincoln district at Yankee, in the northern part of the county.

Griffith district.—The Griffith district embraces the mines at Georgetown and Silver Plume. Silver ores prevail, the only exception being the Centennial mine in Georgetown. At Silver Plume the Dives-Pelican and the Frostburg-Mendota were heavy producers of silver-lead-zinc ores. The Colorado Central, Sunburst, Gumtree, and East and West Griffith were also among the producers. The developments are generally by long tunnels, though the Colorado Central has a vertical shaft 2,000 feet deep. The Doric tunnel was recently driven by an English company 3,000 feet into Griffith Mountain, and the Kelly tunnel penetrates Democrat Mountain for 3,200 feet.

Much of the ore is shipped crude, but concentrating mills are provided on the Dives-Pelican and on the Terrible and the Dunderberg mines, at Silver Plume.

Metallic production of the Griffith district, Clear Creek County, Colo., in 1905.

Year.	Gold.		Silver.		Copper.		Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine oz.		*Fine oz.*		*Pounds.*		*Pounds.*		*Pounds.*		
1905....	992.90	$20,525	319,629	$193,056	17,077	$2,664	2,447,575	$115,036	1,674,069	$98,770	$430,051

Argentine district.—Much activity is reported from the silver district of Argentine on the main range, 10 miles southwest of Georgetown. A narrow-gage road is being constructed from Silver Plume to Argentine, which will provide an outlet for the district, and the production, which was only moderate in 1905, will in all probability increase greatly in 1906. The ores contain both gold and silver, besides copper, lead, and zinc.

Several companies are operating; the principal ones are the Waldorf Mining and Milling Company, the East Argentine Tunnel Company, and the Transcontinental Transportation and Mining Company.

The Waldorf Company is driving a tunnel to be 9,000 feet long, through McClellan Mountain. The maximum depth attained below the surface is to be 2,300 feet. A distance of 2,400 feet is said to be completed at the present time (November, 1906) from the west or Stevens side, while from the eastern or Waldorf side the tunnel has attained a length of 4,500 feet. Many veins are crosscut below the old workings. The company owns a 75-ton concentrating plant.

The Transcontinental Company is operating the Vidler tunnel under the Argentine Pass, through the main divide. The Vidler tunnel is expected to be 7,500 feet long, with a maximum depth of 2,400 feet. A distance of 1,200 feet is said to have been driven already from the Clear Creek side.

CONEJOS AND RIO GRANDE COUNTIES.

Small shipments of silver-gold ore were made from Platoro in Conejos County, close to the Rio Grande line. The district is located about 40 miles southwest from Monte Vista on the Denver and Rio Grande narrow-gauge line to Creede. A short distance northwest from Platoro, but in Rio Grande County, is the Summit (South Mountain) district, from which no production was reported. The Little Annie mine, from which much gold was obtained some twenty-five years ago, is situated in this district. The veins are contained in andesitic lavas, belonging to the same great igneous area which extends northwesterly to Wagon Wheel Gap and Creede.

CUSTER COUNTY.

Metallic production of Custer County, Colo., in 1904 and 1905.

Year.	Gold.		Silver.		Copper.		Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine oz.		*Fine oz.*		*Pounds.*		*Pounds.*		*Pounds.*		
1904....	3,177.37	$65,675	110,367	$63,185	10,910	$1,268	1,200	$52	225	$11	$130,191
1905....	1,205.43	24,918	32,159	19,424	2,500	390	....	....	....	....	44,732

Custer County shows a further decline in its output of gold and silver from the Rosita and Silver districts, which some twenty years ago produced annually several hundred thousand dollars.

The districts are situated in the western foothills of the Wet Mountain Range, about 30 miles south-southwest of Canyon City. The deposits are veins or chimneys or irregular masses in rhyolite. The ores were formerly chiefly silver chlorides and were treated by panamalgamation, but are now mainly sulphides, which are shipped to smelters. The districts have been described by Mr. Whitman Cross in the Seventeenth Annual Report of the Geological Survey.[a] Ores are shipped at present from the Bassick, Bismuth, Little Bernice, and Pioneer mines. The Bassick is developed by two shafts 1,800 and 1,200 feet deep.

A new gold-bearing district was discovered early in 1906 near Ilse, 10 miles northeast of Rosita.

DOLORES COUNTY.

Metallic production of Dolores County, Colo., in 1904 and 1905.

Year.	Gold.		Silver.		Copper.		Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine oz.		*Fine oz.*		*Pounds.*		*Pounds.*		*Pounds.*		
1904....	2,002.43	$41,391	100,194	$57,358	12,201	$1,526	260,584	$11,400	108,795	$5,440	$117,115
1905....	1,681.81	34,766	76,526	46,222	119,821	18,692	840,319	39,495	1,500,000	88,500	227,675

[a] Cross, Whitman, Geology of Silver Cliff and Rosita Hills, Colorado: Seventeenth Ann. Rept. U. S. Geol. Survey, pt. 2, 1896, pp. 269–403.

The table shows a slight decrease in gold and silver as well as a very considerable increase in the output of the base metals, especially zinc. A total of 3,826 tons was treated, derived from 5 mines.

Dolores County adjoins San Juan on the west; the production is derived from the eastern part of the county in the vicinity of Rico, which once was an important silver-lead camp. The ore deposits of Rico, which have been described by Mr. F. L. Ransome in the Twenty-second Annual Report of the Geological Survey,[a] consist of fissure veins and blanket deposits in sedimentary rocks of Carboniferous and later age, intruded by sheets of porphyries. The ores contain galena, zincblende, pyrite, and tetrahedrite, with some secondary, rich silver sulphides.

Pioneer and Lone Cone districts.—The two mining districts from which production is reported are the Pioneer at Rico, embracing the principal silver-lead-zinc mines, and the Lone Cone at Dunton, 15 miles northwest of Rico. In the Lone Cone district the Emma mine is the principal producer; it yields a high grade gold-silver smelting ore with about equal values of the two metals. In the Pioneer district are the United Rico mines, including the famous Enterprise; they are developed by the group crosscut tunnel, 3,000 feet in length, and the ores are at present treated in an experimental plant of 100 tons capacity. The Newman mines are now worked on a small scale by the Swansea Gold and Silver Mining Company. Other mines in operation are the Wellington and Morning Star. An increased production of zinc and lead ores is expected in 1906. Several mines at Rico have adopted the leasing system.

EAGLE COUNTY.

Metallic production of Eagle County, Colo., in 1904 and 1905.

Year.	Gold.		Silver.		Copper.		Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine oz.		*Fine oz.*		*Pounds.*		*Pounds.*		*Pounds.*		
1904....	1,473.63	$30,460	21,011	$12,028	27,042	$3,380	323,969	$14,173	2,310	$116	$60,157
1905....	2,268.34	46,891	46,487	28,078	29,331	4,576	156,723	7,366	2,915,025	171,986	258,897

Eagle County shows a moderate increase in its output of gold, silver, and copper, a decrease in lead, and a heavy increase in zinc; chiefly on account of the latter the total value of metallic products was quadrupled in 1905 compared with 1904. Nine mines were worked against 10 in 1904; the tonnage increased from 1,866 to 12,049 short tons.

Eagle County is situated west of Summit County. Little is known about the geologic features of the deposits, which are stated to be fissure veins in granite or granite porphyry, but sedimentary rocks, such as quartzite, are also present.

The ores are gold and silver bearing sulphides, such as galena and chalcopyrite; in some mines there is also much zincblende. The deposits are generally opened by tunnels, but the Belden has a 900-foot incline shaft. The mines are all situated in the Battle Mountain district in the immediate vicinity of Red Cliff and Gilman, about 30 miles north of Leadville.

Among the producers are the First Chance, the Iron Mask (property of the Pittsburg Gold-Zinc Company), the Ground Hog, the Champion, and the Belden mines. Much manganese and iron ore was also shipped from the Iron Mask mine. Gold deposits are prospected at Fulford, 20 miles east of Red Cliff. A little placer mining is carried on at Burns and other places along the Grand River.

[a] Ransome, F. L., The ore deposits of the Rico Mountains, Colorado: Twenty-second Ann. Rept. U. S. Geol. Survey, pt. 2, 1901, pp. 237-397.

GILPIN COUNTY.

Metallic production of Gilpin County, Colo., in 1904 and 1905.

Year.	Gold.		Silver.		Copper.		Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine oz.		*Fine oz.*		*Pounds.*		*Pounds.*		*Pounds.*		
1904....	53,451.03	$1,104,833	355,354	$203,440	604,791	$75,599	125,731	$5,501	84,750	$4,237	$1,393,610
1905....	70,145.33	1,450,033	340,901	205,904	512,276	79,915	519,841	24,433	191,574	11,303	1,771,588

The most striking change in the metallic production of Gilpin County is an increase of $345,200 in gold. Silver and copper decreased slightly in quantity, but increased in value, and lead and zinc show a notable increase. The metals were extracted from 66 mines, which yielded 182,873 tons, against 55 mines and 109,557 tons in 1904.

Gilpin County, the smallest in Colorado, except Denver, lies between Boulder, on the northeast, and Clear Creek, on the southwest. Topographic maps have recently been completed by the Geological Survey, and a short description of its mines has been published by Mr. G. H. Garrey[a].

The deposits are fissure veins in granite and gneiss, with porphyry dykes, and the vein systems, striking northeasterly, are in the direct continuation of those of Clear Creek County. The ores contain chiefly gold, with some silver and copper. Most of the lead and zinc reported is derived from the the Running Lode mine. In character the ores are partly free milling with sulphides, and the usual treatment is by amalgamation and concentration, either at the mine or in the several custom mills at Idaho Springs, Central, and Black Hawk. A very large quantity of ore is also shipped direct to smelter through sampling works. It is stated in the mining press that Gilpin County has at present 823 stamps.

The veins are generally opened by shafts, the deepest in the county being the California, now filled with water, but extending 200 feet below the level of the Newhouse tunnel, with a total depth of about 2,000 feet. This great tunnel has now penetrated into Gilpin County from Idaho Springs in Clear Creek County. Its total length, (August, 1906) is 16,000 feet, 1,000 feet of which were driven in 1906 and 700 feet in 1905. In Gilpin County the tunnel has intersected the Aududdle, Trentina, Hot Times, and Saratoga veins, and the California mine is 1,000 feet ahead of the present breast.

The Lucania tunnel, which starts from the level of Clear Creek, a short distance above Idaho Springs, is also intended to open the veins of Gilpin County at lower levels.

Among the producing mines of 1905 only some of the most prominent ones can be mentioned: the Old Town, Modoc, Chase, Church, East and West Notaway, Pewabic, Pittsburg, Saratoga, Mackey-Burroughs, Roderick Dhu, Eureka. Gunnel group, Gregory group, Gregory Buell, Running Lode, Alps, and Kansas-Burroughs.

The construction of the Moffat road has opened up the northern part of Gilpin County. Some production is reported from the Mackey and the Evergreen mines near Apex, in Pine district, and development work was done at Rollinsville and Perigo.

GRAND COUNTY.

Grand County, which adjoins Boulder, Gilpin, and Clear Creek counties on the west, has at present only an insignificant production of gold, silver, and copper. Up to the recently begun building of the Moffat Railroad from Denver to Salt Lake this

[a] Garrey, G. H., The Idaho Springs mining district, Colorado: Bull. U.S. Geol. Survey No. 285, 1906, pp. 35–40.

county has been very inaccessible, but it is expected that its mineral resources will be more actively exploited from now on. Little is known about the geological features of the ore deposits. In the northeastern corner of the county are the old Wolverine and other silver-lead deposits, located 12 miles northwest of Grand Lake, which, again, is 15 miles north of Granby railroad station. Twelve miles east from Granby and also near the Boulder County line are promising copper prospects, some of which are owned by the Monarch Mining Company, of Boulder. A branch railroad is projected from Granby to these mines.

A third mining district is the La Plata, which is located in the southeastern part of the county on the headwaters of Williams Fork. The deposits are reported to contain gold, silver, and copper, and some development work is in progress.

GUNNISON COUNTY.

Metallic production of Gunnison County, Colo., in 1904 and 1905.

Year.	Gold.		Silver.		Copper.		Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine oz.		*Fine oz.*		*Pounds.*		*Pounds.*		*Pounds.*		
1904....	1,389.53	$28,720	128,096	$73,335	1,864	$233	19,820	$867	....	....	$103,155
1905....	1,362.05	28,156	53,649	32,404	50,500	7,878	219,809	10,331	101,559	$5,992	84,761

The small gold production of the county remained almost unchanged, while the silver output, also small, decreased considerably; a great increase is observed in the production of the base metals. The output of copper and lead was greater than in 1904, and zinc was added to the list of metallic products. The net result, however, is a decrease in the total value of metallic products from $103,155 to $84,761. Eighteen deep mines reported a total tonnage of 5,581 short tons.

Gunnison is one of the largest counties of the State, and lies between Lake County (Leadville) and the San Juan region. It contains about ten mining districts, lying chiefly in the northeastern and central part of the county on the western slope of the Sawatch Range near the boundary toward Chaffee County, but also in the central and northern parts in the Elk Mountains. The southwestern part belongs largely to the plateau province of horizontal sedimentary rocks. Little is published regarding the mines of the Sawatch Range in the county; but the deposits in the Elk Mountains have been described in Folio 9, United States Geological Survey, comprising Anthracite and Crested Butte quadrangle.[a]

Rock Creek and Crystal River districts.—In the north, near the Pitkin County line, the Rock Creek and Crystal River districts reported some production of copper ore containing gold and silver. The North Pole, the Hard Cash, and the Lead King are among the producers.

Ruby district.—In the Elk Mountain region, the Ruby district at one time was considered of great importance. The veins cut Cretaceous strata in which masses of porphyry are intruded. The Augusta mine reports some production of silver and gold. It has recently been opened by a 3,000-foot crosscut with 2,000 feet of laterals.

Pieplant district.—The Woods mine in the newly-discovered Pieplant district shipped bullion from its newly erected cyanide plant. This district is in the northeastern part of the county, over the range from Winfield, Chaffee County.

Tincup district.—Fifteen miles south of this is the Tincup district, in a similar position across the range from Cottonwood Creek, in Chaffee County. Placers have been

[a] Emmons, S. F., Cross, W., Eldridge, G. H., Anthracite-Crested Butte quadrangle, Colo.: Geologic Atlas U. S., folio 9, U. S. Geol. Survey, 1894.

worked here, as well as fissure veins in granite and silver-lead deposits in limestone and porphyry. The West Gold Hill mine was a gold producer in 1905.

Quartz Creek district.—Ten miles farther south is the Quartz Creek district, near the town of Pitkin, where silver and silver-lead ores are mined in limestone and porphyry. Among the producers were the Maid of Athens, the Citizen, and the Pitkin. Some zinc ore was also shipped. The mines have not attained great depth. The total value of the metallic product of Quartz Creek district was $28,939.

Gold Brick district.—A few miles west of Pitkin, near Ohio City, is the Gold Brick district, in which gold ores prevail. Among the mines are the Cortland, the Golden Islet, the Grand Prize, and the Raymond. The veins are opened by incline shafts up to 400 feet deep, or by tunnels. The Raymond has a 2,300-foot crosscut tunnel and a 20-stamp amalgamation and cyanide mill. The total output of the Gold Brick district in 1905 was $14,649.

Tomichi district.—In the Tomichi district, near Whitepine, in the same region, the Akron mine was a shipper of silver-lead ores.

HINSDALE COUNTY.

Metallic production of Hinsdale County, Colo., in 1904 and 1905.

Year.	Gold.		Silver.		Copper.		Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine oz.		*Fine oz.*		*Pounds.*		*Pounds.*		*Pounds.*		
1904....	372.00	$7,692	39,283	$22,488	10,530	$1,316	1,054,421	$46,129	75,815	$3,791	$81,416
1905....	580.07	11,991	54,419	32,869	84,485	13,180	767,681	36,081	2,085	123	94,244

Hinsdale is one of the counties with comparatively small production. Compared with 1904 gold and silver show a moderate increase in 1905, copper a decided increase, and lead a decline. Ten mines report ore to the aggregate amount of 5,041 short tons.

Hinsdale lies between San Juan and Mineral and includes part of the rugged San Juan Mountains. Most of the deposits are situated at Henson and Capitol City, a few miles west of Lake City on Henson Creek. Some mines are also situated on Lake Fork of Gunnison River, 4 miles south of Lake City.

The topography of the district is mapped in the Lake City quadrangle, and the mines have been described by Mr. J. D. Irving in Bulletin 260, of the United States Geological Survey.[a]

The deposits are fissure veins contained in prevailing rhyolite breccias; near Henson bodies of andesite porphyry are intruded in the rhyolite. No sedimentary rocks are exposed. The prevailing types of veins are silver bearing, with a little gold and galena, chalcopyrite and tetrahedrite. Upper levels usually contain secondary ruby silver ores. The silver-lead ores are shipped to smelters.

The gold-bearing veins form another type characterized by telluride (petzite) ores. Among the silver veins, the St. Jacob, the Excelsior, the Hidden Treasure, the Highland Chief, the Red Rover, and the Wyoming reported production. The old Ute and Ulay mine was idle. Among the gold mines, the Isolde and the Golden Fleece were in operation; the latter is a mine of some renown, having produced about $1,400,000. It is equipped with concentration and cyanide mill, and is opened by several long tunnels.

JEFFERSON COUNTY.

Jefferson County lies, in the main, outside of the principal mineral belt of the State. It contains, however, some copper deposits near Evergreen in the granite

[a] Irving, J. D., Ore deposits in the vicinity of Lake City, Colo.: Bull. U. S. Geol. Survey No. 260, 1905, pp. 78-84.

and schist ridges south of Golden, from which sample lots of copper ore have been shipped.

Two Bucyrus electrically driven dredges were operated during a part of 1905 near Golden, by the National and the Clear Creek dredging companies. The capacity is stated to be 2,500 cubic yards per day.

The ground operated upon is the Clear Creek gravel beds, which extend in three benches about half a mile wide below the Table Mountain of Golden. The gold is fine and consequently difficult to save. Operations have not been resumed in 1906.

LAKE COUNTY.

Metallic production of Lake County, Colo., in 1904 and 1905.

Year.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*		*Pounds.*	
1904	56,886.30	$1,175,841	4,820,596	$2,759,792	3,627,846	$453,480
1905	57,101.87	1,180,401	4,033,762	2,436,392	3,105,710	484,491

Year.	Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
1904	54,392,821	$2,379,686	69,003,890	$3,450,195	$10,218,994
1905	51,162,040	2,404,616	64,856,033	3,826,506	10,332,406

These metals were obtained from 61 mines, which reported a total of 648,464 tons of silver, lead, zinc, and gold ores. These figures represent a small decrease in tonnage from those of 1904. The indications are, however, that a larger tonnage will be reported in 1906.

Lake County is situated almost in the center of the State, between the districts of Clear Creek and Summit counties on the northeast and those of Gunnison and the San Juan on the southwest.

The deposits, which have been described by Mr. S. F. Emmons in the well-known Monograph XII, United States Geological Survey,[a] consist chiefly of flat bodies of ore forming replacements of limestone near contacts of intrusive sheets of porphyry.

The ores of Leadville are reduced by smelting, and ordinarily this is preceded by concentration. There are many different types and a complete and satisfactory classification of them has not yet been attained. They comprise oxidized iron ores for flux, oxidized lead ores, lead and zinc sulphides of shipping grade, dry gold ores, dry silver ores of shipping grade, and dry sulphides. During the last few years the value of the ore has decreased while the tonnage has been greatly increased. The average value of the ores in gold and silver in 1905 was $5.58; in 1904 it attained $5.93. According to New York quotations the combined average lead-zinc-copper value was $10.12 in 1905, giving a total value of $15.93 against $17.14 in 1904; but it must be remembered that the actual average figure paid for the ores by the smelters was much lower than this.

Among the principal producers the following yielded about 90 per cent of the output: A. Y. and Minnie, Big Chief, Boreel, Nisi Prius, New Monarch, Moyer, Ibex and Little Johnnie, Gold Eagle, Fryer Hill, Small Hopes, Sunday, Western Mining Company, and Yak Enterprise.

[a] Emmons, S. F., Geology and mining industry of Leadville, Colo.: Mon. U. S. Geol. Survey, vol. 12, 1886.

Small batches of gold ores may contain up to 2 or 3 ounces, but ordinarily the best values are little more than one-third of an ounce per ton, while few of the sulphide ores contain less than 0.04 ounce per ton. Among the principal gold producers are the Ibex and Little Johnnie, the Golden Eagle, the New Monarch, and the Yak Tunnel. The gold reported from the mines amounted to $1,030,401, but it is known, from smelter returns and from the average gold value of the ores, that more was actually produced; a safe estimate of this excess is $150,000, making the total output of gold $1,180,401.

All of the mines report silver, the quantity in the crude ore ranging from 4 to 14 ounces, though of course smaller quantities of ore run higher.

Only 8 of the 61 mines reported copper, and the total only adds up to 3,105,710 pounds, which probably is considerably less than the quantity actually recovered. The average quantity of copper in the ores would be from 0.25 to 1.25 per cent.

The recent development of an important zinc-mining industry in Leadville is well known. Among the most important producers are the Iron-Silver Mining Company (Moyer mine), the Western Mining Company, the Big Chief Leasing Company, and the Boreel Company. The ore is partly shipped as sulphide concentrates, partly as crude or hand-sorted ore. After the distillation of the zinc by the zinc smelters, the silver-bearing cinders are sold to the lead smelters.

Important developments have taken place in the downtown section. The Midas Company has sunk the Penrose shaft to a depth of 920 feet, and is draining it by means of powerful pumps. The Coronado shaft in the same vicinity is 790 feet deep, and is now drained by a drift from the Penrose. A considerable production was maintained during the year from the Coronado shaft. These pumping operations will open a large and formerly unproductive area.

The Yak tunnel, which now is 10,800 feet in length, extends from California Gulch eastward below Iron and Breece hills. It is planned to pierce the range, and its eastern portal would be in Park County near the London mine. The tunnel is equipped with a very complete system of electric transportation, by which a great number of mines are being served.

During the year the Yak Company completed the Rowe mill at the mouth of the tunnel. The capacity is 250 tons per day, and it is equipped with electrostatic concentrating machines for the separation of the zinc blende.

A certain quantity of crude Leadville ores is shipped to Denver and concentrated there.

LA PLATA COUNTY.

La Plata County reported $251,940 in gold, an increase of $142,789 over the production of 1904. The silver production was 93,258 ounces, an increase of 61,688. Of copper, 2,923 pounds were reported, but no lead or zinc.

The county is situated near the southwestern corner of the State, and includes the southern part of the "San Juan Country." The La Plata Mountains occupy the northwestern part and the Needle Mountain the northeastern part of the county. A smelting plant of the American Smelting and Refining Company is located at Durango, the county seat.

Geological maps are published of the La Plata and Needle mountains quadrangles,[a] and topographic sheets have been issued of the Durango and the Engineer Mountain quadrangles. The Neglected mine is described in Bulletin 260, United States Geological Survey.[b]

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[a] Cross, W., Spencer, A. C., Purington, C. W., La Plata quadrangle, Colorado: Geologic Atlas U. S., folio 60, U. S. Geol. Survey, 1899. Cross, W., Howe, E., Irving, J. D., Emmons, W. H., Needle Mountain quadrangle, Colorado: Geologic Atlas U. S., folio 131, U. S. Geol. Survey, 1905.

[b] Emmons, W. H., The Neglected mine and nearby properties, Durango quadrangle, Colorado: Bull. U. S. Geol. Survey No. 260, 1905, pp. 121-127.

The principal mining district, from which most of the production is derived, is located in the western part of the camp near La Plata, at the head of Junction Creek, and is called the California, sometimes also the Oro Fino. The deposits are fissured zones cutting across the sediments of the lower "Red Beds" and the many porphyry dikes intruded in them. The ores are high-grade tellurides, with some free gold and quicksilver minerals. Silver is also present.

The principal mines worked are the May Day and the Neglected, the latter opened by vertical shaft, the former by crosscut tunnels. The Durango Girl was idle.

In the Needle Mountains district, northeast of Durango, the Aetna mine shipped some ore containing silver, copper, and gold.

MINERAL COUNTY.

Metallic production of Mineral County, Colo., in 1904 and 1905.

Year.	Gold.		Silver.		Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine oz.		*Fine oz.*		*Pounds.*		*Pounds.*		
1904...	10,908.93	$225,487	1,666,309	$953,961	9,304,854	$407,088	1,860,133	$93,007	$1,679,543
1905...	8,812.09	182,162	814,189	491,770	10,576,146	497,079	2,513,457	148,294	1,319,305

Mineral County decreased its production of gold by 2,096.84 ounces, and of silver by 852,120 ounces. On the other hand, its output of zinc increased, and that of lead showed little change. The tonnage of its 10 mines decreased from 124,278 short tons in 1904 to 91,338 tons in 1905.

The county is situated east of Hinsdale and San Juan, and the industry centers at Creede, Amethyst, and Teller, all close together in the northern part of the county. No description of this mining region has as yet been published by the United States Geological Survey, but it is known that the deposits are fissure veins in andesite flows. The ores contain silver, lead, zinc, and gold, the relative value of the metals being in the order indicated. They are of a concentrating type, and little else than concentrates are shipped.

The principal mines are those of the Creede United Mines Company, including the Del Monte, the Last Chance, and the New York claims. Other important mines are the King Solomon, the Amethyst, the Bachelor, and the Commodore. Zinc concentrates were shipped from the King Solomon and the Creede United mines.

The present representative ores of Creede contain 0.1 to 0.2 ounce of gold, 1 to 3 ounces silver, 7 to 8 per cent lead, and 4 to 6 per cent zinc. The zinc is thus really a by-product. The total value of the ore would be nine or ten dollars per ton. The leasing system is extensively used in the mines. The Amethyst is opened by a shaft 1,000 feet in depth, with drifts on many levels; the Bachelor and the Commodore by crosscut tunnels; the New York and the Last Chance by a shaft 1,500 feet in depth; and the King Solomon by an incline shaft 300 feet deep, 400 feet from the portal of a tunnel. The Creede United and the King Solomon have concentrating plants.

OURAY COUNTY.

Ouray County reported $2,333,282 in gold and 306,406 ounces of silver, representing an increase of $158,921 in gold and 42,021 ounces of silver, as compared with the production of 1904. In addition, 52,333 pounds of copper, 2,491,808 pounds of lead, and 48,267 pounds of zinc were reported. A total of 98,966 tons was treated and the average value was $26.74, most of the values being in gold. This was derived from 14 mines.

Ouray is the most northerly of the counties of the San Juan region. The southern part of the county, including the Camp Bird mine, is mapped in the Silverton folio, United States Geological Survey [a]. Descriptions of the mines are found in survey bulletins by F. L. Ransome [b] and J. D. Irving [c].

Ouray County comprises four mining districts: Uncompahgre, Sneffels, Imogene Basin, and Red Mountain.

Uncompahgre district.—Uncompahgre district is situated close to the town of Ouray or a little north of it. Sedimentary rocks ranging in age from pre-Cambrian to Cretaceous are cut by various kinds of porphyries as sheets or dikes. The ores appear in fissure veins, or as replacement deposits of limestone or quartzite, and contain silver, gold, copper, lead, and zinc, as tetrahedrite, galena, chalcopyrite, and zinc-blende. The character of the ores varies considerably in the several kinds of deposits, but they are generally high grade and are shipped to smelters. The mines are almost without exception developed by adit tunnels. Among the producers in 1905 were the American-Nettie, the Memphis group (Bright Diamond), the Mickey Breen, and the Portland.

Production of the Uncompahgre district, Ouray County, Colo., in 1905.

Gold.		Silver.		Copper.		Lead.		Zinc.		Total value.
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
Fine oz.		*Fine oz.*		*Pounds.*		*Pounds.*		*Pounds.*		
1,483.71	$30,671	26,569	$16,048	16,972	$2,648	66,195	$3,111	46,767	$2,759	$55,237

Imogene Basin.—The great Camp Bird mine is located in Imogene Basin, and the northwesterly trending vein cuts through the great masses of the San Juan tuff, which here cover the sedimentary formations. According to published report, the Camp Bird mine produced $2,263,136, of which $2,175,645 was in gold, the rest consisting of silver and lead, with a little copper. The tonnage treated was 74,744 short tons. The mine is developed by a 2,200-foot tunnel and a shaft 769 feet deep. The mill has 60 stamps, the crushing being followed by amalgamation, concentration, and cyanide process. This mill was destroyed by a snowslide early in 1906, and the production for that year will necessarily be curtailed.

Sneffels district.—In the Sneffels district, a short distance to the northwest from the Camp Bird, is the Revenue tunnel, which pierces the ridge and has its southern portal in San Miguel County. This was also an important producer. The ores contain prevailing silver, but also gold and lead, and are treated by stamp milling (60 stamps), followed by concentration. Production was also reported from the Atlas and the Calliope mines. The Atlas is opened by a 1,200-foot tunnel, and the San Pedro tunnel has attained the same length.

Red Mountain district.—The Red Mountain district is located in the most southerly corner of the county, and in former years was renowned as a producer of lead and copper ores, very rich in gold and silver. The Yankee Girl was the best known of these mines. Recently important development work has begun in this district. The Red Mountain Railroad, Mining and Smelting Company is driving the long Joker tunnel for the purpose of unwatering these old mines, some of which were tapped early in 1906. Among the producers for 1905 are the Bobtail and Moscow, the Mountain Lion group, the Oom Paul, the Treasury tunnel group, and the Joker tunnel.

[a] Cross, W., Howe, E., Ransome, F. L., The Silverton quadrangle, Colorado: Geologic Atlas U. S., folio 120, U. S. Geol. Survey, 1905.

[b] Ransome, F. L., Economic Geology of the Silverton quadrangle, Colorado: Bull. U. S. Geol. Survey No. 182, 1901.

[c] Irving, J. D., Ore deposits of the Ouray quadrangle, Colorado: Bull. U. S. Geol. Survey No. 260, 1905, pp. 50–77.

Metallic production of Red Mountain District, Ouray County, Colo., in 1905.

Year.	Gold.		Silver.		Copper.		Lead.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ounces.		*Fine ounces.*		*Pounds.*		*Pounds.*		
1905....	4,795.75	$99,137	44,950	$27,150	35,622	$5,557	305,043	$14,337	$146,181

PARK COUNTY.

Metallic production of Park County, Colo., in 1904 and 1905.

Year.	Gold.		Silver.		Copper.		Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine oz.		*Fine oz.*		*Lbs.*		*Lbs.*		*Lbs.*		
1904....	a19,190.00	a$396,661	57,064	$32,670	....	....	156,270	$6,837	51,750	$2,588	a$438,756
1905....	a24,014.84	a496,431	49,202	29,718	12,199	$1,903	543,303	25,535	....	....	a553,587

a Includes gold product of Jefferson and Summit counties.

A substantial increase is noted in the combined gold production of Park, Summit, and Jefferson counties, while there was a slight decrease in the output of silver in the first-named county. The copper and lead production in Park County has increased, but no zinc is reported. Nineteen mines, of which 5 were placers, contributed to the production, and the tonnage of ore from deep mines was 6,745 short tons.

Chaffee, Lake, and Summit counties adjoin Park County on the west and Clear Creek lies to the north. Little geological information is available concerning its productive mineral deposits, which are confined to the vicinity of Fairplay, Alma, and Doran, on the eastern slope of the ragged Mosquito Range, near the place where Lake, Summit, and Park counties join.

Mosquito district.—Placers are still worked at Alma, in the Mosquito district, and preparations are made to open the mines on a large scale. Bowlders interfere somewhat with the work. The predominant types of ores near Alma occur in fissure veins or blanket deposits, in limestone, or porphyry, and contain galena, chalcopyrite, and tetrahedrite, with silver and gold. In the Mosquito district are situated the New York and the London mines. The latter, 7 miles northwest of Alma, is a very important producer of high grade gold ores, with some lead and silver. The deposit is opened by long tunnels, and is reported to consist of a fissure vein in porphyry. The New York mine is shipping silver ores.

Buckskin district.—The Buckskin district, a few miles north of Alma, produces some silver or gold-silver ore, sometimes carrying lead and copper.

Early in 1906 a new mineralized district was found near Hartsel, in the South Park, on the Colorado Midland Railroad. Small quantities of gold are reported to be distributed through large masses of rhyolite tuff.

The whole central and eastern part of the county is barren of producing mines.

PITKIN COUNTY.

From Pitkin County the following metallic production was reported in 1905: Gold, $248; silver, 2,469,520 ounces; copper, 41,276 pounds; lead, 22,386,142 pounds; zinc, 5,268,091 pounds. Gold decreased $723, as compared with 1904; silver increased 319,485 ounces. A considerable increase is also noted in copper and lead. Most important of all the changes is the great development of the zinc mining industry, from nominal figures in 1904 to a value of $310,817 of metallic zinc in 1905. In 1905, 107,927 short tons were produced from 25 mines.

Some silver-gold-lead ores are reported from the Lincoln Gulch district, but with this exception the whole production of the county is confined to the immediate vicinity of Aspen. The geology of Aspen is described in detail by Mr. J. S. Spurr in Monograph XXXI, United States Geological Survey.[a] The town is situated 35 miles west of Leadville, and there is some similarity in geological structure between the two districts. At Aspen paleozoic limestones and shales are invaded by masses and sheets of diorite and granite porphyry. Very complicated faulting is characteristic of the district, and the ores have developed by replacement of the limestone along the fault planes.

Roaring Fork.—The output is almost wholly confined to Smuggler and Aspen Mountains, and the whole district is known as the Roaring Fork. The ores are chiefly argentiferous galena and zinc blende. The rich bonanzas of Mollie Gibson and other mines, which some fifteen years ago yielded masses of polybasite and native silver, are now exhausted. There is practically no gold and very little copper in the ores. The Mineral Farm group on Smuggler Mountain is drained by the Cowenhoven tunnel, which is almost 12,000 feet long. A rather high-grade silver-lead ore is shipped. The Smuggler mine shipped a heavy tonnage of lead-silver-zinc ore and slimes to Canyon City for the manufacture of zinc-lead pigment. A very large part of the total zinc shipments are derived from this mine. The Percy-La Salle group on Aspen Mountain is drained by the Newman tunnel, 3,800 feet in length. Most of the heavy tonnage of lead-silver ore was shipped crude to smelters. The Durant mine on Aspen Mountain was a heavy producer of lead-silver ore. Some of the other producers of lead-silver ores are the Argentum-Juniata, Aspen, Bushwhacker, and Keystone mines.

The tenor of the silver reported varies from 10 to 48 ounces per ton, but rises in some small shipments as high as 370 ounces. The lead is reported at from 1 per cent to 15 per cent. Much of the ore is shipped crude to smelters. Four concentrating mills are built along Roaring Fork and Hunter Creek, and have a combined capacity of about 850 tons. There is one 150-ton zinc plant, and the other mills are for lead and lead-zinc ores; of these the most important is the 400-ton lead concentrating mill of the Smuggler, which is provided with crushers, rolls, jigs, Huntington regrinding mills, tables, and vanners. The 100-ton Cowenhoven mill is located on Hunter Creek. On Richmond Hill is the 50-ton Famous mill, and in Taylor Park, 35 miles away, is the 100-ton Enterprise mill.

ROUTT COUNTY.

This formerly very inaccessible county in the northwestern corner of the State will soon be opened by the Moffat Road, now under construction.

Hahn's Peak district.—The production of the county has chiefly been confined to a small quantity of placer gold, though a little rich lead ore was in former years shipped to Leadville at great expense. The producing district is located near Hahn's Peak, in the northeastern part of the county; it has recently been described in Bulletin 285, by Mr. H. S. Gale,[b] of the United States Geological Survey. A mass of rhyolite-porphyry, making up the mass of Hahn's Peak, is here intruded into Cretaceous and earlier rocks. Placers have been worked on the southern slope of the mountain; gold ores are found within the intrusive rock, and silver-leaded ores in the Cretaceous sediments close by.

[a] Spurr, J. S., Geology of the Aspen mining district, Colorado: Mon. U. S. Geol. Survey, vol. 31, 1898.

[b] Gale, H. S., The Hahn's Peak gold field, Colorado; Bull. U. S. Geol. Survey No. 285, 1905, pp. 28–34.

SAGUACHE COUNTY.

Metallic production of Saguache County, Colo., in 1904 and 1905.

Year.	Gold.		Silver.		Copper.		Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine oz.		*Fine oz.*		*Pounds.*		*Pounds.*		*Pounds.*		
1904....	418.00	$8,641	47,233	$27,041	48,066	$6,011	18,000	$787	13,500	$675	$43,155
1905....	33.82	699	4,401	2,658	1,135	177	203,797	9,578	....	....	13,112

Blake and Baca grant districts.—The small metallic output of Saguache County declined in 1905 to $13,112. Some silver, copper, and lead is reported from the Blake district near Villa Grove, and some gold from Eastern Star and Alamosa near Crestone, on the Baca grant, both districts in the foothills of Sangre de Cristo Range.

Kerber Creek district.—The Rawley mine at Bonanza, in the Kerber Creek district, 16 miles west of Villa Grove, shipped silver-lead ores.

SAN JUAN COUNTY.

The reported production from San Juan County in 1905 was $1,050,971 in gold, a decrease of $685,258 from 1904, and 750,844 ounces of silver, a decrease of 834,094. Of copper, 1,675,858 pounds were produced; of lead, 8,045,126 pounds, and of zinc, 248,627 pounds. The total value of metallic products decreased from $3,593,205 in 1904 to $2,158,705 in 1905. Twenty mines reported an output of 204,139 short tons, against 31 mines and 233,663 short tons in 1904.

The small county of San Juan, located on the southern slope of the San Juan Mountains, contains very important mineral deposits. The region has been fully described and mapped by F. L. Ransome in the Silverton folio and in Bulletin 182, United States Geological Survey.[a]

The mines extend from Silverton in a northeast direction up Animas Fork to Eureka and beyond. In general they are worked on great systems of fissure veins striking northwest or west and are contained in the enormous masses of volcanic, chiefly andesitic, flows which cover this whole part of the country. The bulk of the ores are of milling grade, averaging $7 to $10 per ton, but much shipping ore with silver and lead, as well as concentrates, is produced.

Among the important mines is the the Gold King which, according to the published report of the company, produced $655,504 in the year ending September, 1905, from 72,339 short tons of ore. The bullion extracted amounted to $194,180, and the concentrates had a value of $461,324. The 80-stamp mill, with wet crushing and amalgamation, is one of the largest in the State, having a capacity of 300 tons, and is equipped with an elaborate slime plant, comprising tube mills and slime table. A large mill of 500 tons capacity is under construction for the Gold Prince mine. The Sunnyside, also located near Eureka, is an important producer. The Silver Lake mines on Kendall Mountain were heavy producers of silver, gold, copper, and lead; the equipment consists of a 300-ton concentrating mill.

The Silver Ledge group, at Chattanooga, 8 miles northwest of Silverton, produced less than in 1904, but remains an important shipper of concentrates containing silver, gold, lead, and zinc. The mill has a capacity of 200 tons, and is provided with Chilian mills, Wilfley tables, and Blake electrostatic separators. A new mill is built on the Old Hundred mine. Among the producers not already mentioned are the Brooklyn, the Hamlet, the North Star, the Ruby Basin, and the mines of the Eureka Exploration Company.

[a] Loc. cit.

Early in 1906 snowslides damaged the Shenandoah and the Green Mountain mills, the latter just completed, and fire partly interrupted the operations of the Silver Lake mill. Withal a considerable increase in the production of San Juan County should be expected in 1906. Electric power is now available for the mines by the recent construction of the Animas Power Company's plant.

SAN MIGUEL COUNTY.

Metallic production of San Miguel County, Colo., in 1904 and 1905.

Year.	Gold.		Silver.		Copper.		Lead.		Total.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine oz.		*Fine oz.*		*Pounds.*		*Pounds.*		
1904....	83,639.95	$1,728,838	1,329,184	$760,958	245,709	$30,714	6,184,375	$270,567	$2,791,077
1905....	82,810.89	1,711,853	1,275,079	770,148	17,721	2,764	6,970,152	327,597	2,812,362

The production of San Miguel County shows little change in 1905. The county remains one of the most important mining sections of the State. In value of total metallic product it slightly exceeds Ouray and San Juan, and in tonnage mined—291,338 short tons from 19 mines—it stands at the head of the San Juan counties. The average value of ore is $9.58. San Miguel County occupies the western part of the San Juan region, and its ore deposits have been fully described by Mr. C. W. Purington in folio 57, United States Geological Survey.[a]

Upper San Miguel district.—The great, continuous northwesterly trending fissure veins of the Liberty Bell, the Smuggler Union, and the Tomboy in the Upper San Miguel district, northeast of Telluride, cut across thick masses of lavas and tuffs and belong to the same system as the Camp Bird and the Revenue deposits in the adjoining Ouray County. The Liberty Bell is opened by a crosscut tunnel 3,000 feet long. The ore which carries gold with some silver is treated in an 80-stamp amalgamation mill with tube mills for fine grinding, and cyanide plant.

The Smuggler Union mine is opened by a 7,000-foot crosscut tunnel and contains ores with almost as much silver by value as gold. They are treated in two large stamp mills, using similar processes.

The Tomboy mine, which is owned by an English corporation, yields principally gold, but also much lead. The mine is opened by shafts, drifts, and crosscuts aggregating 19,482 feet. The ore is treated in a 60-stamp mill of a capacity of 800 tons; the process used is plate amalgamation and concentration on 36 vanners.

Metallic production of Upper San Miguel district, San Miguel County, Colo., in 1905.

Year.	Gold.		Silver.		Copper.		Lead.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine oz.		*Fine oz.*		*Pounds.*		*Pounds.*		
1905....	76,171.64	$1,574,607	890,459	$537,837	1,923	$300	4,976,234	$233,883	$2,346,627

Iron Springs district.—In the Iron Springs district, which for the present purpose may be considered to include the mines on Yellow Mountain and Silver Mountain near Ophir, there was much activity. The Alta, the Suffolk, and other mines on Silver Mountain work on veins in the San Juan tuff, but they continue down into the Cretaceous sediment. The Butterfly-Terrible, the Montezuma, and others are on veins

[a] Purington, C. W., The Telluride quadrangle, Colorado: Geologic Atlas U. S., folio 57, U. S. Geol. Survey, 1899.

in intrusive masses of granite porphyry or monzonite porphyry, intrusive. From the Alta mines leaders rich in silver and gold were shipped. The Butterfly-Terrible treated gold ores in a 30-stamp, plate-amalgamation mill. The Carribeau-Montezuma mines concentrated and shipped a considerable amount of silver-lead ores. Among other producers of the same type of ore were the Carbonero, the Little Mary, and the New Dominion, while the Suffolk yielded some gold ore.

Metallic production of the Iron Springs district, San Miguel County, Colo., in 1905.

Year.	Gold.		Silver.		Copper.		Lead.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine oz.		*Fine oz.*		*Pounds.*		*Pounds.*		
1905....	5,494.23	$113,576	381,412	$230,391	15,798	$2,464	1,970,733	$92,624	$439,055

Lower San Miguel and Mount Wilson districts.—A small output is recorded from the Lower San Miguel district, 10 miles west-northwest of Telluride, and from the Mount Wilson district, 10 miles southwest of the same place.

Placer operations were carried on by the Keystone Hydraulic Mining Company on bench gravels below Telluride.

SUMMIT COUNTY.

Metallic production of Summit County, Colo., in 1904 and 1905.

Year.	Gold.		Silver.		Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine oz.		*Fine oz.*		*Pounds.*		*Pounds.*		
1904....	9,793.84	$202,443	292,149	$167,255	5,592,140	$244,658	1,884,584	$94,229	$708,585
1905....	([a])	([a])	209,356	126,451	2,181,660	102,538	3,320,237	195,894	[a]424,883

[a] Summit County gold product included in Park County.

Less silver and lead were produced in Summit County in 1905 than in 1904, but a great improvement was noted in the zinc industry. No copper was reported.

Placer mining near Breckenridge, on the several branches of the Blue River, has always been an important branch of mining, and 1905 was a successful year. The Banner mine, in Iowa Gulch on Blue River, was operated, and many improvements were made. The gravel banks are 20 to 30 feet high, and three giants are operated. The Mecca Company is sluicing in the lower part of French Gulch. The Reliance dredge in French Gulch was in successful operation.

The deep mines near Breckenridge in general produce a gold-silver-lead-zinc ore, which is shipped to smelters. The first mine to produce zinc was the Old Union, on which a 100-ton concentrating plant is erected. Other mines shipping zinc ores are the Wellington, the Sally Barber, and the Bullion King. All of those mentioned and several others also ship silver-gold-lead ores. The total metallic value of the deep mines near Breckenridge in 1905 was about $280,000.

The Jessie mine, in Swan River Valley, is an important producer of free milling gold ore with some lead, which is treated in the mine mill.

Much development work is going on between Frisco and Kokomo, among others, by the King Solomon Tunnel and Development Company.

A small production of lead-silver ores is reported from the Peru and Montezuma districts near Argentine, over the range from Georgetown.

Tenmile district.—In the southern part of the county, north of Leadville, is the Tenmile district, including the towns of Kokomo and Robinson. The district has been described in detail by Mr. S. F. Emmons in folio 48, United States Geological Survey,[a] in which it is shown that the ore deposits occur as veins or blankets in a series of Carboniferous limestones and sandstones intruded by sheets of diorite porphyry. The ores consist of pyrite, galena, and zinc blende. The revival of the district is due to the utilization of the zinc ores. Among the producing mines are those of the Delaware Mining Company, the George Milo, the Michigan group, and the Selma group. Large concentrating plants are being erected at Kokomo by the Delaware Company and the Summit Mining and Smelting Company.

Metallic production of the Tenmile district, Summit County, Colo., in 1905.

Year.	Gold.		Silver.		Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ozs.		*Fine ozs.*		*Pounds.*		*Pounds.*		
1905....	2,957.67	$61,140	110,437	$66,704	1,035,929	$48,689	1,267,458	$74,780	$251,313

An increased production from Summit County is to be expected in 1906.

TELLER COUNTY.

The production of Teller County in 1905 amounted to $15,411,724 in gold, and 49,449 ounces of silver, worth $29,867, a total of $15,441,591 of gold and silver. This was obtained from 716,358 short tons of ore. Compared with 1904, the gold production shows an increase of $907,374, the silver production a decrease of 17,189 ounces, and the tonnage an increase of 118,539 short tons. The average gold and silver content per ton decreased from $24.33 in 1904 to $21.56 in 1905.

The reported production of gold was $15,211,724, which includes the yield of some old tailings treated during 1905 by the reduction companies. An estimate of $200,000 has been added to this amount to allow for the production of a number of small mines, the owners of which could not be reached, and for the returns from small assay offices. Some of the latter product is believed, by well-informed people, to be derived from ore stealing. It was also necessary to estimate the silver output, as only a few thousand ounces are reported from the mines. The silver comes chiefly from the smelting ores, but the quantity per ton is very small, and no payment is, as a rule, made by the smelters for this metal. In the chlorination process no silver is recovered.

Teller County represents the Cripple Creek district, as no other producing mining districts are located within its boundaries. The familiar facts of the occurrence of extraordinarily rich gold telluride veins within the small area of a volcanic vent in the granite of the plateau southwest of Pikes Peak need not be retold, as they have been described in the report of Messrs. Cross and Penrose,[b] and by Messrs. Lindgren and Ransome in a bulletin and professional paper[c] of the same bureau.

The Cripple Creek district has experienced a very successful year, although the production has not reached the record-breaking figures of 1900, 1901, and 1902. Barred from prospecting the deep levels by water, many mining companies have explored the upper workings and have met with great success, once more demonstrating the almost incredible richness of the veins within the space of a thousand feet from the surface.

[a] Emmons, S. F., Tenmile district (Colorado), special folio: Geologic Atlas U. S., folio 48, U. S. Geol. Survey, 1898.

[b] Cross, W., and Penrose, R. A. F., jr., Geology and mining Industries of the Cripple Creek District, Colorado: Sixteenth Ann. Rept. U. S. Geol. Survey, pt. 2, 1895, pp. 13-209.

[c] Lindgren, W., and Ransome, F. L., Geological resurvey of Cripple Creek District, Colorado: Bull. U. S. Geol. Survey No. 254, 1904. Also, Geology and gold deposits of the Cripple Creek District: Prof. Paper U. S. Geol. Survey No. 54, 1906.

The future drainage of the district is at present the most important problem. The larger part of the producing area is now drained by the El Paso tunnel, which has an elevation of 8,790 feet at the portal, and through which a large quantity of water still flows. In October, 1905, a report was made by Mr. D. W. Brunton to the Mine Owners' Association on the driving of a much deeper drainage tunnel, the portal elevation of which would be 7,660 feet, the length about $3\frac{1}{2}$ miles, and the depth gained below the El Paso tunnel 1,130 feet; it would drain the district about 3,200 feet below the summit of Bull Hill and about 2,000 feet below Beacon Hill. The probable cost would be $700,000. The work has not yet begun (October, 1906), though it is stated that a large part of the money is subscribed. A tunnel of somewhat higher level is advocated by some, while certain of the mine owners in the eastern part of the district are skeptical about the efficiency of the tunnel to drain that vicinity. The probability is that the production of the district will somewhat decrease in 1906.

About two-thirds of the tonnage, yielding one-half of the total production, is treated in the chlorination mills of the Portland and the United States Reduction and Refining companies at Colorado City, and by the Economic Mill at Victor. The smelters received one-quarter of the tonnage, probably yielding about $6,000,000. Of the remainder, perhaps 40,000 short tons were treated in the Dorcas cyanide mill at Florence, and 50,000 or 60,000 tons in the local non-roasting cyanide mills at Cripple Creek.

The lately developed supremacy of the chlorination plants is being contested, for the Golden Cycle and affiliated companies are now building a large roasting and cyanide mill at Colorado City, under the direction of Mr. Philip Argall. The small non-roasting cyanide plants at Cripple Creek have treated more ore in 1905 than ever before, but the ore supply suitable for them is no doubt limited, especially as the semioxidized ores do not readily yield to the treatment. The Wild Horse and the Dexter plants were operated, as well as the Anaconda Homestake, the Los Angeles, and the Sioux Falls mills. Small plants were constructed on the Santa Rita and the Home Run mines on Squaw Mountain.

The following table gives the production of the Cripple Creek district from 1891 to 1905:

Production of the Cripple Creek district, Colorado, 1891–1905.[a]

Year.	Gold.	Silver.	Year.	Gold.	Silver.
		Fine ounces.			*Fine ounces.*
1891	$449	....	1900	$18,073,539	80,166
1892	583,010	....	1901	17,261,579	90,884
1893	2,010,367	5,019	1902	16,912,783	62,690
1894	2,908,702	25,900	1903	12,967,338	42,210
1895	6,879,137	70,448	1904	14,504,350	66,638
1896	7,512,911	60,864	1905	15,411,724	49,449
1897	10,139,709	57,297	Total	154,331,096	762,280
1898	13,507,244	68,195			
1899	15,658,254	82,520			

[a] Figures for 1891-1903 from reports of the Director of the Mint; figures for 1904 and 1905 from reports of the United States Geological Survey.

Eighty-eight mines reported production in 1905, as against 102 in 1904. Among these 25 produced more than $100,000 each. An increasing number of mining companies now publish annual reports.

The Portland retained its leading position with an output of $2,422,033 contained in 109,233 short tons of ore.

Stratton's Independence was largely worked by about 25 sets of lessees, who have met with astonishing success in opening up new ore bodies above the 500-foot level. The deepest level is under water. The output was $1,825,080 and the average per ton very high, nearly $40. Some extremely rich ore has been extracted. The question of treating the very low-grade ores in the extensive dumps is under consideration.

The Vindicator Company continued its successful career and produced 24,070 short tons of ore, much of which was of a $40 grade. The total production was $893,125. Toward the last part of the year the Vindicator obtained control over the Independence Consolidated, whose land adjoins on the northwest. Preparations were made to recover the 1,100 and 1,200 foot levels by pumping.

In the El Paso mine the shaft was sunk 400 feet below the level of the El Paso tunnel, the water being held in check by heavy pumping. Splendid results are reported from the exploration of these lower levels, which however were destined to come to a sudden stop early in 1906, the irresistible influx of water soon filling the mine to the tunnel level. The El Paso mine produced $984.504 from 25,200 short tons of ore.

The Findley and Shurtloff mine yielded $680,415 from 22,189 short tons of ore. The fifteenth level is unwatered, and the ore shown to exist here is one of the most promising features of recent work in Cripple Creek. The company announced its decision to treat its own ores in the future, and the mining work will be temporarily discontinued until proper facilities for reduction are provided.

The Golden Cycle still remains one of the largest mines of the district. The company is erecting a cyanide mill in Colorado City and is preparing to sink the shaft below the 1,000-foot level.

The Elkton, finding itself unable to explore in depth on account of water, has had excellent success in opening ores at higher levels. One of the most important strikes of 1905 was made in the Gregory lease on Elkton ground.

In the Cresson group the Bull Hill Mining and Developing Company opened an important producer in a hitherto barren territory in a gulch between Bull and Raven Hills. The Forest Queen, north of Midway, is also said to have a large body of ore. Good ore shoots are reported from the 1,000-foot level in the Strong mine, and from the 1,200-foot level in the Granite mine.

The Mary McKinney, though limited by the water, had a successful year, and recently acquired control of the Anaconda. The United Gold Mines Company, of Woods Investment Company, operated a number of their many mines. On the large holdings of Stratton's Estate the leasing system proved a success, and the output was considerably increased.

Other producers of note were the Ajax, now mainly operated by lessees, the Dead Pine, the Dillon, the Gold Sovereign, the Hull City, the Jerry Johnson, the Last Dollar, the Ophir, the C. K. & N., and the Theresa.

IDAHO.

By V. C. Heikes.

PRODUCTION.

The metal production of Idaho for the calendar year 1905, as reported by 257 producers, including 152 placers, totaled $19,743,620. Of this total the gold yield was 52,033 ounces, valued at $1,075,618; and silver, 8,679,093 ounces, which at the average commercial price was valued at $5,242,172, or a total value for the precious metals of $6,317,790. This is an increase of $218,421 over the 1904 production, and is attributed to the gain in silver from the Coeur d'Alene lead ore in Shoshone County. During 1905 the tonnage of ore mined, milled, and smelted amounted to 1,669,038 short tons, averaging $11.62 per ton for the gold, silver, copper, lead, and zinc. Of this value, the ore averaged 44 cents in gold and $3.14 in silver, an average total value for gold and silver of $3.58 per ton. A comparison of these figures with corresponding ones for 1904 shows that the value of the total metal output increased $2,810,215. The ore tonnage increased 711 short tons, and the total value per ton increased from $9.84 in 1904 to $11.62 per ton in 1905, an increase of $1.78 per ton, due largely to the lead and silver contents of the ore. In 1904 the average total gold value of the ore was 73 cents per ton, silver $2.63 per ton, or a total value for both metals of $3.36 per ton. A comparison of these figures with those of 1905 shows a decrease of 29 cents per ton in gold, and that the silver increased 51 cents per ton. The increases and decreases in the metal output of the State for 1905 are as follows: Gold decreased 30,706 ounces and $634,747 in value; silver increased 1,012,711 ounces and $853,168 in value.

The statement of production for 1904 and 1905 figured at each year's average commercial prices is as follows:

Production of gold, silver, and associated metals in Idaho in 1904 and 1905.

Metal.	1904.		1905.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold......fine ounces..	82,739	$1,710,365	52,033	$1,075,618	− 30,706	− $634,747
Silver ....do....	7,666,382	4,389,004	8,679,093	5,242,172	+ 1,012,711	+ 853,168
Copper ....pounds..	5,087,518	635,940	7,321,585	1,142,167	+ 2,234,067	+ 506,227
Lead ....do....	233,096,375	10,197,966	259,812,428	12,211,184	+26,716,053	+2,013,218
Zinc..............do....	2,600	130	1,228,449	72,479	+ 1,225,849	+ 72,349
Total............	....	16,933,405	....	19,743,620	....	+2,810,215

Production of metalliferous ores in Idaho in 1904 and 1905.

	1904.		1905.		Increase.	Increase per ton.
	Short tons.	Value per ton.	Short tons.	Value per ton.	*Short tons.*	
Ore output	1,668,327	$9.84	1,669,038	$11.62	711	$1.78

GOLD.

The total gold production for Idaho amounted to 52,033 ounces, valued at $1,075,618 in 1905, as against 82,739 ounces valued at $1,710,365 in 1904, a decrease of 30,706 ounces in quantity and of $634,747 in value. As in former years, the greatest yield of gold from deep mines came from Owyhee County, and Boise County leads in the production of placer gold. Decreases in nearly all the counties were recorded for 1905, due generally to water shortage, which restricted the output of both the placer mines and the deep mines, as the latter depended to a considerable extent on water for power and mill purposes.

In the table of production by kinds of ore in 1904 and 1905 it is shown that the greatest decrease in gold was in the siliceous ore, and that there were increases in lead ore and copper ore. The gold from siliceous ore is won almost entirely by amalgamation, and was the greatest in amount of all classes in 1905, but decreased 23,970 ounces, as did the gold from placers 7,379 ounces, and from copper-lead ore 25 ounces. Increases are recorded in copper ore of 295 fine ounces; lead ore, 290 ounces; copper-lead-zinc ore, 9 ounces; lead-zinc ore, 74 ounces. The decrease in the placer gold was general all over the State. The table of gold production of Idaho placers shows the output for both 1904 and 1905, and gives the quantity of placer gold derived from hydraulic, drift, and dredge mining. Besides Boise County, the placer output is an important item in other counties, which named in order of greatest production are Idaho, Shoshone, Lemhi, and Elmore, each producing during 1905 over 1,000 ounces of gold. Hydraulic mining is carried on extensively in each of these counties, and in addition to this method of mining, Idaho County produces largely by drift mining, and Boise by dredging operations. Since 1904 inclusive the placer product of Shoshone County has been reduced for the reason that the rich placer region, including Pierce City, was annexed to Nez Perce County. Some important hydraulic and dredge mining gives the promise of making the output of Nez Perce County one of consequence another year. The yield of placer gold from a number of the districts in Idaho is necessarily estimated, as it is impossible to reach many of the prospectors and men who work small mines, or to get any reliable data from them when found. From Snake River placers a total of $27,018 was recovered in 9 counties. This represents a decrease of about $6,000 from the figures of 1904. In the following tables will be found the yield of gold from different kinds of ore for 1905, and also for 1904 and 1905:

Source of gold production in Idaho by kinds of ore in 1905, by counties.

[Fine ounces.]

County.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Mixed ores.			Grand total.
					Copper-lead-zinc ore.	Copper-lead ore.	Lead-zinc ore.	
Ada and Bannock	104	73						177
Bingham	276							276
Blaine	258			3	9		76	346
Boise	6,351	721		288				7,360
Canyon	71							71
Cassia	140					1		141
Custer	947	299	385	1				1,632
Elmore	1,126	5,389						6,515
Fremont								0
Idaho	2,289	8,254						10,543
Kootenai			3					3
Latah	225							225
Lemhi	1,440	3,239		70				4,749
Lincoln	156							156
Nez Perces	951	259						1,210
Oneida	393							393
Owyhee	68	14,798						14,866
Shoshone	1,640		246					1,886
Washington	35	1,250	199					1,484
Total	16,470	34,282	833	362	9	1	76	52,033

The following table shows the production of gold in Idaho in 1904 and 1905, with increase or decrease:

Production of gold in Idaho in 1904 and 1905 by kinds of ore, with increase or decrease.

[Fine ounces.]

Year.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Mixed ores.			Grand total.
					Copper-lead-zinc ore.	Copper-lead ore.	Lead-zinc ore.	
1904	23,849	58,252	538	72		26	2	82,739
1905	16,470	34,282	833	362	9	1	76	52,033
Increase (+) or decrease (−)	−7,379	−23,970	+295	+290	+9	−25	+74	−30,706

SILVER.

The silver yield amounted to 8,679,093 ounces, valued at $5,242,172, in 1905, as against 7,666,382 ounces, valued at $4,389,004, in 1904, an increase of 1,012,711 ounces in quantity and of $853,168 in value. Shoshone County has the greatest increase, due entirely to the production of the Coeur d'Alene region, which is credited with 7,292,986 ounces. Of this quantity, 331 ounces were derived from placer bullion, 390,000 ounces from copper ores, 6,891,344 ounces from lead ores, 5,894 ounces from copper-lead ore, and 5,417 ounces from lead-zinc ore, which is mined principally for its zinc. The increased tonnage of lead ore and copper ore is responsible for the larger yield of silver in Shoshone County. Ranking second in the silver yield, Owyhee County is credited with a production amounting to 846,035 ounces, all of which is secured from siliceous ores, an increase of 43,745 ounces over 1904. Blaine County derived from its lead ore silver amounting to 335,756 ounces. The mixed ore containing associated minerals of copper, lead, and zinc produced 24,743 ounces of silver, and the ore with minerals of lead and zinc produced 14,046 ounces of silver. The ore mined for its zinc in Blaine County contains lead, and consequently is not classified as a straight zinc ore. There are 13 silver mines in Idaho that may be classified as such, since the quantity of silver in their productions exceeded the other metals. The silver output of Idaho decreased in placers and siliceous ores, but increased in all the other kinds of ores, as shown by the table of production for 1904 and 1905 that follows:

Source of silver production in Idaho by kinds of ore in 1905, by counties.

[Fine ounces.]

County.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Mixed ores.			Grand total.
					Copper-lead-zinc ore.	Copper-lead ore.	Lead-zinc ore.	
Ada and Bannock	16	100						116
Bingham	4							4
Blaine	9			335,756	24,743		14,046	374,554
Boise	1,478	182		300				1,960
Canyon	3							3
Cassia	11					16		27
Custer	524	230	24,452	11,408				36,614
Elmore	186	2,769						2,955
Fremont	0		6					6
Idaho	254	4,905						5,159
Kootenai	0	7,080	14,292					21,372
Latah	21							21
Lemhi	421	336		38,600				39,357
Lincoln	6							6
Nez Perces	193							193
Oneida	15							15
Owyhee	7	846,035						846,042
Shoshone	331		390,000	6,891,344		5,894	5,417	7,292,986
Washington	3		57,700					57,703
Total	3,482	861,637	486,450	7,277,408	24,743	5,910	19,463	8,679,093

The following table shows the production of silver in Idaho in 1904 and 1905, with increase or decrease:

Production of silver in Idaho in 1904 and 1905 by kinds of ore, with increase or decrease.

[Fine ounces.]

Year.	Placers.	Sicileous ore.	Copper ore.	Lead ore.	Mixed ores.			Grand total.
					Copper-lead-zinc ore.	Copper-lead ore.	Lead-zinc ore.	
1904	7,622	867,443	201,843	6,582,354	....	3,000	4,120	7,666,382
1905	3,482	861,637	486,450	7,277,408	24,743	5,910	19,463	8,679,093
Increase (+) or decrease (−)	4,140	−5,806	+284,607	+695,054	+24,743	+2,910	+15,343	+1,012,711

COPPER.

Copper is becoming an important factor in the metal production of Idaho. The rise in the price has encouraged operators to open up properties and in several instances to make shipments for long distances by wagon to the railroad. The output of copper for the State has increased from 5,087,518 pounds, valued at $635,940, in 1904, to 7,321,585 pounds, valued at $1,142,167, in 1905, an increase over 1904 of 2,234,067 pounds in quantity and of $506,227 in value.

The greatest yield in the State is credited to the Coeur d'Alene region, in Shoshone County. The copper output of this county increased from 1,424,440 pounds, valued at $178,055, in 1904, to 5,225,606 pounds, valued at $815,194, in 1905, an increase of 3,801,166 pounds in quantity and of $637,139 in value. The output was treated at the smelters in Montana and at Tacoma, Wash. Ranking second in the copper output is Washington County, with the Seven Devils district as the principal region of production. The output increased from 898,209 pounds, valued at $112,276, in 1904, to 1,403,493 pounds, valued at $218,945, in 1905, an increase of 505,284 pounds in quantity and of $106,669 in value. The ore from the county was nearly all treated at the Sumpter smelter in Oregon. Custer County is third in rank in the copper output, which came from the mines at Mackay and vicinity. The output decreased from 2,734,489 pounds, valued at $341,811, in 1904, to 685,484 pounds, valued at $106,935, in 1905, a loss of 2,049,005 pounds in quantity and of $234,876 in value. The decrease was caused principally by the idleness of the smelter at Mackay. Other counties producing copper were Blaine, Fremont, Kootenai, and Cassia.

LEAD.

The lead produced in Idaho increased from 233,096,375 pounds, valued at $10,197,966, in 1904, to 259,812,428 pounds, valued at $12,211,184, in 1905, an increase of 26,716,053 pounds in quantity and of $2,013,218 in value. This increase in the output is credited almost entirely to the Coeur d'Alene region in Shoshone County. A small production came from Boise and Cassia counties also.

ZINC.

Zinc became an important factor in the medal output of the State during 1905. In 1904 Blaine County recorded the first production and, increasing the yield in 1905, was followed by Shoshone County, with an important output. During 1905 zinc ore and concentrates were shipped from Blaine County, and from Shoshone County a concentrate product was shipped to the zinc smelters by the Success Mining Company, which has erected a 100-ton water concentration plant at the Granite mine in the Coeur d'Alene district.

MINING INDUSTRY IN IDAHO IN 1905.

As a feature of progress in 1905, the increased yield of copper and zinc may be emphasized. The rate of increase in the output of these two metals brings Idaho forward as one of the possible large producers of these metals.

The construction of a custom lead smelting establishment was carried on at Ponderay, in Kootenai County, and a copper plant for the Lost Packer mine, in Custer County, was finished. The experiments in concentrating the river sands and the beach sands of the Western States carried on by the United States Geological Survey, at Portland, Oreg., showed that much of this material found in Idaho carries good values. The best returns were made on a sample of sand submitted from west of Blackfoot, which carried 19.62 ounces gold and 0.18 ounce platinum per ton. One other sample submitted from the bank of Snake River carried several times as much platinum, but not nearly so much gold as the Blackfoot sample. In addition to the values thus found the Survey identified a number of other minerals in the sands, a partial list of which follows: Ilmenite, zircon, monazite, chromite, rutile, epidote, titanite, columbite, and cinnabar. To some extent the results of these tests stimulated the building of dredges and the equipment of idle plants with improved machinery; the operation of dredges along Snake River was under consideration, notably below Blackfoot, American Falls, Glenns Ferry, and 8 miles below Weiser; and preparations were also made in other localities, as in Boise basin and in Stanley Basin, at Pierce City, in Nez Perce County, and near Murray, in Shoshone County.

Among the milling operations considerable interest has been evinced in the leaching plant which the Snowstorm company has been erecting at its copper property above Mullan. It is reported that test runs on 4½ per cent carbonate and oxide ore proved the possibility of an 88 per cent extraction. In southern Idaho the most important event was the successful initial run of the new cyanide plant at the Lincoln property in the Pearl camp of Boise County. In Owyhee County the De Lamar mill was dismantled in August and improved machinery was added. Cyanide will continue to be employed for the extraction of the values.

Established milling plants and those erected during the year were in many instances unable to operate the entire year for the lack of sufficient water. Placer mining generally suffered for a like reason. Railroad building was carried on almost entirely in the agricultural sections. The Pacific and Idaho Northern Railroad, which connects at Weiser with the Oregon Short Line, was working on the extension from Council to Meadows, in Washington County. This will benefit mining in the Seven Devils district and in the country around the Warren district in Idaho County.

Work has been energetically prosecuted on the wagon road from Roosevelt to the Big Creek section of Idaho County, and it is hoped to have the road completed before the year closes. The State wagon road which is to connect Atlanta in Elmore County with Boise City by way of the Boise River was begun and half completed.

On the south fork of the Payette River, at the upper end of Garden Valley, in Boise County, a new electric power plant is being constructed, which may supply power to the dredges in Boise basin.

The statistical tables appearing in the following sections of this report for the year 1905 show the quantity and value of the production of the noble and base metals of the State. The distribution of gold, silver, copper, lead, and zinc, and the quantities and values of the production are given by counties for the year 1905 in the table which follows.

Production of gold, silver, copper, lead, and zinc in Idaho in 1905, by counties.

County.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine oz.		*Fine oz.*		*Pounds.*	
Ada and Bannock	177	$3,659	116	$70		
Bingham	276	5,705	4	2		
Blaine	346	7,152	374,554	226,230	2,312	$361
Boise	7,360	152,145	1,960	1,184		
Canyon	71	1,468	3	2		
Cassia	141	2,915	27	16	540	84
Custer	1,632	33,736	36,614	22,115	685,484	106,935
Elmore	6,515	134,677	2,955	1,785		
Fremont	0	0	6	4	2,350	367
Idaho	10,543	217,943	5,159	3,116		
Kootenai	3	62	21,372	12,909	1,800	281
Latah	225	4,651	21	13		
Lemhi	4,749	98,171	39,357	23,772		
Lincoln	156	3,225	6	4		
Nez Perce	1,210	25,013	193	116		
Oneida	393	8,124	15	9		
Owyhee	14,866	307,308	846,042	511,009		
Shoshone	1,886	38,987	7,292,986	4,404,963	5,225,606	815,194
Washington	1,484	30,677	57,703	34 853	1,403,493	218,945
Total	52,033	1,075,618	8,679,093	5,242,172	7,321,585	1,142,167

County.	Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
Ada and Bannock					$3,729
Bingham					5,707
Blaine	3,983,833	$187,240	1,084,449	$63,983	484,966
Boise	2,064	97			153,426
Canyon					1,470
Cassia	8,280	389			3,404
Custer	166,589	7,830			170,616
Elmore					136,462
Fremont					371
Idaho					221,059
Kootenai					13,252
Latah					4,664
Lemhi	1,796,000	84,412			206,355
Lincoln					3,229
Nez Perce					25,129
Oneida					8,133
Owyhee					818,317
Shoshone	253,855,662	11,931,216	144,000	8,496	17,198,856
Washington					284,475
Total	259,812,428	12,211,184	1,228,449	72,479	19,743,620

The following table is prepared for the purpose of showing the increase and decrease, by quantity and value, of the metals produced as compared with the production of 1904:

Increase (+) and decrease (−) of production of metals in Idaho in 1905 as compared with 1904, by counties.

County.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine oz.		*Fine oz.*		*Pounds.*	
Ada and Bannock	+ 33	+ $682	− 210	− $116	− 21,600	− $3,075
Bingham	− 202	− 4,176	+ 4	+ 2		
Blaine	+ 155	+ 3,204	− 113,721	− 53,307	+ 2,312	+ 361
Boise	− 6,905	−142,739	− 36,370	− 20,760	− 500	− 63
Canyon	+ 63	+ 1,302	+ 3	+ 2		
Cassia	− 140	− 2,894	+ 10	+ 6	+ 540	+ 84
Custer	− 2,032	− 42,006	+ 283	+ 1,315	−2,049,005	−234,876
Elmore	+ 3,147	+ 65,054	+ 1,466	+ 933		
Fremont	− 4	− 83	+ 6	+ 4	+ 2,350	+ 367
Idaho	− 4,041	− 83,535	− 1,601	− 754		
Kootenai	− 1,336	− 27,617	− 5,597	− 2,531	+ 1,520	+ 246
Latah	− 68	− 1,406	+ 21	+ 13		
Lemhi	− 7,439	−153,777	− 5,118	− 1,690	− 5,000	− 625
Lincoln	− 5	− 103	+ 6	+ 4		
Nez Perce	+ 353	+ 7,298	− 559	− 315		
Oneida	38	− 786	+ 15	+ 9		
Owyhee	− 8,718	−180,216	+ 43,752	+ 51,698		
Shoshone	340	− 7,028	+1,149,985	+888,095	+3,801,166	+637,139
Washington	689	− 14,242	− 12,664	− 5,432	+ 505,284	+106,669
Undistributed	− 2,500	− 51,679	− 7,000	− 4,008		
Total	− 30,706	−634,747	+1,012,711	+853,168	+2,234,067	+506,227

County.	Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
Ada and Bannock					− $2,509
Bingham					− 4,174
Blaine	− 1,602,286	− $57,153	+1,081,849	+$63,853	− 43,042
Boise	+ 2,064	+ 97			− 163,465
Canyon					+ 1,304
Cassia	+ 8,280	+ 389			− 2,415
Custer	− 68,124	− 2,439			− 278,006
Elmore					+ 65,987
Fremont					+ 288
Idaho					− 84,289
Kootenai	− 280,700	− 12,279			− 42,181
Latah					− 1,393
Lemhi	− 31,400	+ 4,463			− 151,629
Lincoln					− 99
Nez Perce					+ 6,983
Oneida					− 777
Owyhee					− 128,518
Shoshone	+28,688,219	+2,080,140	+ 144,000	+ 8,496	+3,606,842
Washington					+ 86,995
Undistributed					− 55,687
Total	+26,716,053	+2,013,218	+1,225,849	+72,349	+2,810,215

The tonnage of ore sold or treated, the number of mines producing ore, the average value per ton, and the value per ton in gold and silver, are shown as follows:

Tonnage of ore sold or treated, number of mines producing, and tenor of ores in Idaho in 1904 and 1905, by counties.

County.	Total tons of ore sold or treated.		Deep mines producing.		Average value per ton.		Average value per ton in gold and silver.		Value of gold and silver in ore.
	1905.	Increase (+) or decrease (−).	1904.	1905.	1904.	1905.	1904.	1905.	
	Short tons.	*Short tons.*							
Ada and Bannock	210	+ 74	2	2	$38.27	$7.47	$15.65	$7.47	$1,569
Bingham									
Blaine	18,845	− 6,185	9	14	20.94	25.45	11.17	12.10	228,044
Boise	1,788	− 16,135	20	9	6.27	11.88	6.27	11.83	21,149
Canyon									
Cassia	9	+ 9		1		56.00		3.44	31
Custer	14,504	− 59,580	10	6	5.40	10.39	1.01	2.48	35,958
Elmore	11,226	+ 7,685	8	10	19.38	10.07	19.38	10.07	113,073
Fremont	3	+ 3		1		123.66		1.33	4
Idaho	28,181	− 8,186	10	15	6.75	6.16	6.75	6.16	173,588
Kootenai	70	− 1,087	2	2	23.99	189.31	13.34	185.30	12,971
Latah									
Lemhi	17,271	− 14,475	16	9	9.81	10.21	7.27	5.32	91,920
Lincoln									
Nez Perce	200	− 132	4	2	14.43	26.77	14.43	26.77	5,354
Oneida									
Owyhee	43,031	− 16,005	5	4	16.02	18.98	16.02	18.98	816,907
Shoshone	1,526,927	+116,682	20	27	9.62	11.24	2.50	2.89	4,409,848
Washington	6,773	− 1,957	6	3	22.44	41.89	9.58	9.57	61,804
Total	1,669,038	+ 711	112	105	9.84	11.62	3.36	3.58	5,975,220

The total tonnage of ore sold or treated in each county of Idaho during 1905, with its total value, the concentrates and bullion produced, with their values, and the quantity and value of old tailings, are shown in the following table:

Tonnage and value of ore, concentrates, bullion, and old tailings treated in Idaho in 1905, by counties.

County.	Total ore.		Concentrates produced.		Gold-silver bullion produced.		Old tailings treated.	
	Quantity.	Value.	Quantity.	Gold and silver value.	Quantity.	Value.	Quantity.	Gold and silver value.
	Short tons.		*Short tons.*		*Ounces.*		*Short tons.*	
Ada and Bannock	210	$1,569			174	$1,536		
Bingham								
Blaine	18,845	479,628	4,115	$200,908				
Boise	1,788	21,246	148	4,771	957	14,101		
Canyon								
Cassia	9	504						
Custer	14,504	150,723			529	6,180		
Elmore	11,226	113,073			8,353	103,090	1,000	$6,500
Fremont	3	371						
Idaho	28,181	173,588	238	13,820	13,639	155,621		
Kootenai	70	13,252						
Latah								

Tonnage and value of ore, concentrates, bullion, and old tailings treated in Idaho in 1905, by counties—Continued.

County.	Total ore.		Concentrates produced.		Gold-silver bullion produced.		Old tailings treated.	
	Quantity.	Value.	Quantity.	Gold and silver value.	Quantity.	Value.	Quantity.	Gold and silver value.
	Short tons.		*Short tons.*		*Ounces.*		*Short tons.*	
Lemhi	17,271	$176,332	190	$3,306	3,237	$58,056		
Lincoln								
Nez Perce	200	5,354			150	2,175	100	$3,000
Oneida								
Owyhee	43,031	816,907	170	448,168	250,361	365,960		
Shoshone	1,526,927	17,164,754	179,497	3,012,976			6,620	5,372
Washington	6,773	283,749			1,250	25,000		
Total	1,669,038	19,401,050	184,358	3,683,949	278,650	731,719	7,720	14,872

The gold and silver production of placers in Idaho is given by counties for the year 1905 in the following table:

Production of placers in Idaho in 1905, by counties.

[Fine ounces.]

County.	Gold.	Value.	Silver.	Value.	Total value.
Ada	104	$2,150	16	$10	$2,160
Bingham	276	5,705	4	2	5,707
Blaine	258	5,333	9	5	5,338
Boise	6,351	131,287	1,478	893	132,180
Canyon	71	1,468	3	2	1,470
Cassia	140	2,894	11	6	2,900
Custer	947	19,576	521	317	19,893
Elmore	1,126	23,276	186	113	23,389
Idaho	2,289	47,318	254	153	47,471
Latah	225	4,651	21	13	4,664
Lemhi	1,440	29,768	421	255	30,023
Lincoln	156	3,225	6	4	3,229
Nez Perce	951	19,659	193	116	19,775
Oneida	393	8,124	15	9	8,133
Owyhee	68	1,406	7	4	1,410
Shoshone	1,640	33,902	331	200	34,102
Washington	35	724	3	2	726
Total	16,470	340,466	3,482	2,104	342,570

The placer production of Idaho for 1904 and 1905 is given for the different methods of mining in the following table:

Gold production of Idaho placers by different methods, 1904 and 1905.

[Fine ounces.]

Year.	Hydraulic.[a]	Drift.	Dredge.	Total.
1904	18,737	317	4,795	23,849
1905	14,346	463	1,661	16,470

[a] Includes sluicing.

The following table gives for 1905 the number of mines classified according to their chief product.

Number of mines classified by chief product in Idaho in 1905, by counties.

County.	Nonproducing mines.	Mines reporting product.	Gold placer mines.				Deep mines.					Total.
			Hydraulic.	Drift.	Dredge.	Total.	Gold.	Silver.	Copper.	Lead.	Zinc.	
Ada and Bannock	19	4	2			2	1	1				23
Bingham	11	7	7			7						18
Blaine	61	18	4			4				11	3	79
Boise	88	40	30		1	31	7	1		1		128
Canyon		4	4			4						4
Cassia	10	7	6			6				1		17
Custer	39	10	3		1	4	2		2	2		49
Elmore	45	13	3			3	8	2				58
Fremont	8	1							1			9
Idaho	129	45	23	7		30	13	2				174
Kootenai	40	2						2				42
Latah	20	7	7			7						27
Lemhi	172	19	10			10	6	1		2		191
Lincoln	7	2	2			2						9
Nez Perce	47	27	25			25	2					74
Oneida		2	2			2						2
Owyhee	27	7	3			3		4				34
Shoshone	133	37	8	1	1	10			2	24	1	170
Washington	48	5	2			2	1		2			53
Total	904	257	141	8	3	152	40	13	7	41	4	1,161

Idaho has 21 counties. From 20 of these counties mine operators reported production of metals in 1905. Records show 159 mining districts in the State, 79 of which have a production credited to them for 1905, as against 93 in 1904. The counties producing minerals to a total value of over 400,000 in 1905, named in order of importance, are Shoshone, Owyhee, and Blaine. In the following section a brief review is given of each of the productive counties.

REVIEW BY INDIVIDUAL COUNTIES.

ADA COUNTY.

Mine operators in this county reported production from 2 deep mines and from placers along Boise and Snake rivers. · The development work in the deep mines has been encouraging, as well as the progress in the placer-mining industry through the installation by the Utility Power Company on the Ada County side of Snake River of a dredge which promises good results. This plant is expected to treat 1,500 yards of gravel a day. It will be operated by electric power generated at Crane Falls.

From the Black Hornet district one small shipment was made and considerable development work was reported. The Twentieth Century Gold Mining Company (Limited), reports the opening up of a great ore body of low-grade ore in this tunnel. The ore is said to average about $5 in value, principally in gold.

In the Shaw Mountain district, on the Boise County line, 10 miles to the northeast of Boise City, are located the mining claims of the Big Giant Gold Mining Company (Limited). The main lead is developed to a depth of about 400 feet by upward of

1,500 feet of crosscut and drift work. The ore is a white quartz associated with iron sulphides, through which the gold-silver values are disseminated.

In the Neal district, the Gold Eagle mine, operated by a company of the same name, began operations during March with a mill of 60 tons daily capacity, turning out concentrates and saving some gold by amalgamation. After a short run the mill was closed down. Later in the year cyanide tests were made on the sands after amalgamation, and a satisfactory saving reported. Some development work was done on the old Ironsides mine, which is located about 12 miles east of Boise City. The ore is quartz, containing iron, lead, and zinc sulphides. The mine has approximately 2,000 feet of development. The Equitable Mining Company, operating the X-Ray mine, is continuing to explore the property.

BANNOCK COUNTY.

Development work in a tunnel over 3,000 feet in length is still carried on by the Fort Hall Mining and Milling Company in the Fort Hall district, about 12 miles east of Pocatello. In the same district, the Pocatello Gold and Copper Company developed the Moonlight claims on North Pocatello Creek. Its underground workings aggregate about 1,000 feet and consist of shallow tunnels, whereby a continuous ore chute of 125 feet has been exposed. None of the ore extracted was shipped in 1905. The shipments made the previous year gave good returns in copper and silver.

BEAR LAKE COUNTY.

The Bear Lake district, located about 16 miles east of Montpelier not far from the Wyoming line, is attracting some attention. It is reported that there are in the California mine lodes aggregating 150 feet in thickness that will average from $4 to $6.50 per ton. Development consists of about 2,400 feet of tunnel work.

BINGHAM COUNTY.

The reports of production came from 7 placer operators, one in the Mount Pisgah district, the others along Snake River. The quantity of gold was 276 ounces, silver 4 ounces, or a total value of $5,707. The American Hydraulic Placer Mining Company, operated at Gray, in the Mount Pisgah district, with hydraulic giants, during a short season. Along Snake River the placer operations are mostly performed by caving the high gravel banks with ditches run near the edge of each embankment, which as it falls is broken up and carried along the current to sluices leading to the burlap tables and rockers. The 2 dredges located on the river in the county are being put into shape for operation. Various mishaps prevented these dredges from operating during 1905. The largest part of the gold output came from Snake River.

BLAINE COUNTY.

This county ranks third in the State in value of its metal output for 1905. From reports received by the United States Geological Survey, its production comes from 18 producing properties, which may be classed as 4 placers, 11 lead, and 3 zinc mines. The total quantity of crude ore treated or shipped amounted to 18,845 short tons, valued at $479,628, or a total average value per ton of $25.45, of which the gold and silver content averaged $12.10 per ton. The quantity and value of each metal produced from deep and placer mines in Blaine County during 1904 and 1905 with increase and decrease are shown in the table which follows.

Production of gold, silver, and associated metals in Blaine County, Idaho, in 1904 and 1905, with increase or decrease.

Metal.	1904.		1905.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
DEEP MINES.						
Gold ......ounces..	4	$83	88	$1,819	+ 84	+$1,736
Silver ......do....	488,275	279,537	374,545	226,225	− 113,730	−53,312
Copper ......pounds..	....	....	2,312	361	+ 2,312	+ 361
Lead ......do....	5,586,119	244,393	3,983,833	187,240	−1,602,286	−57,153
Zinc ......do....	2,600	130	1,084,449	63,983	+1,081,849	+63,853
PLACERS.						
Gold ......ounces..	187	3,865	258	5,333	+ 71	+ 1,468
Silver ......do....	....	....	9	5	+ 9	+ 5
Total	....	528,008	....	484,966	....	−43,042

Production of metalliferous ore in Blaine County, Idaho, in 1904 and 1905.

	1904.		1905.		Decrease, short tons.	Increase per ton.
	Short tons.	Value per ton.	Short tons.	Value per ton.		
Ore output	25,030	$20.94	18,845	$25.45	6,185	$4.51

The origin of the precious metals is given, by different kinds of ore, in the following table:

Source of gold and silver in Blaine County, Idaho, 1904 and 1905, by kinds of ore.

[Fine ounces.]

Metal.	Year.	Placers.	Lead ore.	Mixed ores.		Total.
				Copper-lead-zinc ore.	Lead-zinc ore.	
Gold	1904...	187	2	....	2	191
	1905...	258	3	9	76	346
Silver	1904...	....	484,155	....	4,120	488,275
	1905...	9	335,756	24,743	14,046	374,554

The placer-mining industry was productive only from the Snake River region.

Mineral Hill district.—The principal mining towns of this important district are Hailey and Bellevue. The most important productive mines are within a few miles of these towns, which are reached from Shoshone, on the main line of the Oregon Short Line Railroad, by a branch railroad which has its terminus at Ketchum. The Minnie Moore mine, half a mile from Bellevue, still ranks as the most important producer of lead-silver ore, yet its production in 1905 was less than in 1904, because a greater amount of development work was found necessary in looking for new ore bodies. The occurrence of these ore bodies has baffled the operators continuously. The development consists of a 1,000-foot 40-degree incline shaft, a 250-foot shaft, and various drifts driven from each level. The mill is equipped to treat 100 tons of ore a day, by the use of jigs and Wilfley tables. The Della Mountain Mining Company is working a silver-lead mine, which is developed by tunnels. The ore is concentrated by hand jigs. The Jay Gould mine is located on the Mayflower vein, which has in the past been the most productive vein system in the Wood River region. The Jay Gould is an old mine, and considerable development work has been done on it. During 1905 it was in the hands of lessees, who during the last few months found ore in three parts of the mine. They have about 100 tons of second-class ore on the dump that will average about 80 ounces silver and 23 per cent lead per ton. The first-class ore, which was being hauled to the railroad, was worth about $100 per ton. The Quincy Junior Mining Company continued to operate the Red Elephant mine and mill during the year. Connection was made in the mine between the 500 and 600 foot levels, where some high-grade ore, carrying gold, silver, and lead, is under development. The War Dance mine was operated by the Wood River Zinc Company until the first part of December. The development consists of 8,000 feet in tunnel work and a shaft 100 feet deep, with drift at that depth run 300 feet. The ore produced was concentrated in the 100-ton milling plant belonging to the company, and the zinc concentrates were shipped to the Kansas smelters. This company recently acquired the Nay Aug mine, and has been shipping regularly since the transaction took place. A tunnel 800 feet with upraises is under development. For 330 feet in this tunnel the company has opened up a continuous ore body. All the zinc ore produced thus far has been shipped direct to the Kansas smelters, and the lead-silver ores have been sold in Salt Lake City.

Rosetta district.—This district is located 24 miles west of Ketchum. The Dollarhide Mining Company is the principal property in the district. Development consists of tunnels aggregating 1,800 feet. The Dollarhide vein is a strong, well-defined fissure, traversing the country in a northeast and southwest direction, with a dip of about 60° to the southwest. The company is completing a concentration mill of 40 tons daily capacity. The ore contains zinc, iron, and lead sulphides carrying silver. In addition to the lead concentrates, a zinc product will be made in the new mill. The Smoky Bullion mine, in the same district, is being extensively developed, and was a producer in 1905.

Warm Springs district.—The Lucky Boy mine, located 12 miles west of Ketchum, was operated by the Lanyon Zinc Company, and produced with very little sorting a high-grade zinc ore, which was shipped direct to the Kansas smelters. The mine is developed by a tunnel 250 leet long. Other properties were operated in this district, and outputs were made during the year by the Black Carbonate group, owned by the Carbonate Hill Mining Company, the Navy group, operated by the Sampson Mining Company, and the North Star, Free Boer, and Free Coinage mines. Placer mining was productive only from the Snake River regions. The most extensive placer operations on Snake River were by a firm operating the Riverside placers, near Neeley. For experimental purposes the operations were carried on with a steam-pumping plant which forced the water into a flume built on a level with the top of the gravel banks, and by the ditches, to the point of attack, where the current assisted in caving and carrying the débris into sluices, thus concentrating on burlap tables the black sands and the gold. These operators had installed on Fall Creek, on the opposite side of Snake River, an expensive electric-power equipment, which was expected to operate the pumping plant, but the rising of the waters of the reservoir will necessitate the dismantling of the pumping plant and will make the ground a valuable dredging proposition.

BOISE COUNTY.

The ores sold or treated in this county in 1905 amounted to 1,788 short tons, valued at $21,246, as against 17,923 short tons, valued at $112,297, in 1904, a decrease of 16,135 short tons in quantity and of $91,051 in value. The total average value per ton was $6.27 in 1904 and $11.88 in 1905. Gold and silver, with insignificant quantities of copper and lead, were the only metals produced from ores in the county. The placer yield decreased from 9,890 ounces, valued at $204,445, in 1904, to 6,351 ounces, valued at $131,287, in 1905. The contents and commercial values of the output are as follows:

Production of gold, silver, and associated metals in Boise County, Idaho, in 1904 and 1905.

Metal.	1904.		1905.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
DEEP MINES.						
Gold .... ounces..	4,375	$90,439	1,009	$20,858	− 3,366	−$69,581
Silver .... do....	38,070	21,795	482	291	−37,588	− 21,504
Copper .... pounds..	500	63	....	....	− 500	63
Lead .... do....	....	....	2,064	97	+ 2,064	+ 97
PLACERS.						
Gold .... ounces..	9,890	204,445	6,351	131,287	− 3,539	− 73,158
Silver .... do....	260	149	1,478	893	+ 1,218	+ 744
Total	....	316,891	....	153,426	....	−163,465

Ore production in Boise County, Idaho, in 1904 and 1905.

	1904.		1905.		Decrease.	Increase per ton.
	Short tons.	Value per ton.	Short tons.	Value per ton.		
					Short tons.	
Ore output	17,923	$6.27	1,788	$11.88	16,135	$5.61

The origin of the precious metals by different kinds of ore is given in the following table:

Source of gold and silver in Boise County, Idaho, in 1904 and 1905, by kinds of ore.

[Fine ounces.]

Metal.	Year.	Placers.	Siliceous ore.	Lead ore.	Total.
Gold	1904	9,890	4,375	....	14,265
	1905	6,351	721	288	7,360
Silver	1904	[a]6,260	38,070	....	44,330
	1905	1,478	182	300	1,960

[a] This quantity is an estimate, and does not appear in the county totals.

The decrease in the output is due principally to the fact that 20 lode mines and 43 placers reported production in 1904, as against 9 lode mines and 31 placers in 1905. The operations on the lode mines were mainly development work, and the ores extracted were experimented with by the cyanide process and by concentration methods. The tests thus far made are in the majority of instances favorable to the cyanide method, since if it can be successfully adopted the precious-metal bullion can be produced at the mine. High freight rates by wagon and rail prohibit the shipping of concentrates.

Boise basin region.—The Belshazzar and Centennial property is attracting more attention than any in the district. The mine is opened by 3 tunnels, the longest one being 850 feet. They all show ore of good grade, and the mill results have been very satisfactory. However, in the third level considerable iron pyrite is appearing in the ore, and the extraction by amalgamation is not so good. Experiments are being made to cyanide the ore. Owing to a break in the aerial tramway belonging to the company, during the last part of October the mill was closed down. On the Lucky Baldwin claim some development work was done during the year. There is a 5-stamp mill on the property. The Gold Hill and Iowa Group Mines Company is developed by a vertical shaft 400 feet deep on the Gold Hill and by tunnels on the Iowa claim, which is equipped with a 20-stamp mill. The tailings dump at the old mill was leased and the tailings were successfully treated by the cyanide process. The Sunday mine, equipped with a 5-foot Huntington mill and cyanide plant, successfully extracted $1,100 gold by amalgamation from a test of 125 tons of ore, and 5 tons of concentrates, which assayed $80 per ton, are being tested by cyanide. In Deadwood basin the Merry Blue and the Union claims were developed during the year, and a test was made of some of the ore. On Summit Flat are located the Golden Chest and the Mammoth mines. These properties were actively developed during the year. The deepest shaft is 400 feet. The property is equipped with a 2-stamp Hendy mill. Owing to a small supply of water, placer operations in Boise basin were limited. Placer mining in this region is carried on by dredges and hydraulic giants, from which the greatest part of the gold production is derived. There are 4 dredges in the basin, but during 1905 only one dredge operated, one was in process of construction, and the other two were idle. However, considerable testing of the gravel was done preparatory to starting operations again, when electric power will be provided from the plant being built on the South Fork of the Payette River, 11 miles north of Centerville. The Corcoran Bar was worked by the dredge of the Moline Mining Company; and hydraulic plants on Leary and Brogan placers, Oaks placers, and the McMasters placers turned out considerable gold.

West View district.—The Gold Dollar Mining and Smelting Company produced from the Dewey group and the Checkmate property, which is developing by a vertical shaft 500 feet deep, with various laterals. The 10-stamp mill was burned during the year, but a neighboring 5-stamp plant, equipped for concentration, was leased. The Lincoln Mining Company (Limited) has its property developed by a vertical shaft over 300 feet deep. The reduction plant, equipped with Chilian mill and concentration tables, ran the first four months of the year. This has been improved by the installation of a complete cyanide plant. This property was an important producer in 1904; in 1905 extensive experiments for more economic extraction were made. The Whitman Mining Company is doing most of its development work on the Red Warrior and the Leviathan, with a 300-foot crosscut tunnel, which will develop both claims. The 5-stamp mill treats the ores taken out in development by amalgamation and concentration.

CANYON COUNTY.

The production of this county was as follows: Gold, 71 ounces, valued at $1,468, making, with the associated silver, a total value of $1,470. The entire output came from small placer operations on Snake River. The West View mining district, which overlaps this county, has its production recorded in Boise County.

CASSIA COUNTY.

The production of this county came from 1 deep mine and 6 placer mine operations. The entire product was valued at $3,404, consisting of gold, 141 ounces; silver, 27 ounces; copper, 540 pounds; and lead, 8,280 pounds. Development work on claims in the Stokes district was done in 1905 by the Cumora Mining and Milling Company. From Twin Falls, in Cassia and Lincoln counties, to a point up the Snake River, above Fall Creek, in Oneida and Blaine counties, the great reservoir for irrigation purposes covers a space nearly 40 miles long by 2 miles wide at several points. This reservoir extends over much ground which has been productive in the past through small placer operations, which caught the gold on burlap and rockers. These methods will be superseded by the dredge, the only means of working the ground and one full of possibilities of success. Several companies have been organized for the purpose of working the placers systematically, and are encouraged by the tests made by the United States Geological Survey at Portland, Oreg., during 1905. These tests have shown that every sample of black sand concentrates from Snake River gravels contained besides gold small quantities of platinum.

CUSTER COUNTY.

Probably no county in Idaho during 1905 received more attention from capital and made greater preparations for a substantial increase in the production of its mineral output. Its many mines can be made productive by economical modes of reduction, and with this end in view the Lost Packer Mining and Smelting Company installed a hot-blast pyritic copper furnace of 100 tons daily capacity, which was completed in November, but too late to get a run before the close of the season. The plant will treat custom ore, as well as that produced from its own properties. Coke and supplies are hauled from Mackay, the terminus of a branch of the Oregon Short Line Railroad, 85 miles long, operating from Blackfoot, and thence by a 130-mile wagon haul to the mine by way of Challis and Custer.

Sea Foam district.—In the Sea Foam district the Greyhound Mountain Mining and Milling Company installed a small pyritic smelter during the year, to treat ore from the Greyhound mine.

Bay Horse district.—In the Bay Horse district the lead smelter of the Clayton Mining and Smelting Company, located 26 miles south of Challis, was idle. At Mackay the smelter and mine belonging to the White Knob Copper and Developing Company is operated by the Macbeth lease. The smelter was operated part of the year. With 4 smelters operating, which is a possibility for 1906, the output of the county is likely to be of considerable importance. According to reports received from 10 operators, the output of crude ore amounted to 14,504 short tons, valued at $150,723, which with the placer product, valued at $19,893, made the total value of the metal output $170,616 in 1905. The average total value of the ore was $10.39 per ton. The total quantity of each metal produced, with the value of each, is as follows: Gold, 1,632 ounces, valued at $33,736; silver, 36,614 ounces, valued at $22,115; copper, 685,484 pounds, valued at $106,935; lead, 166,589 pounds, valued at $7,830. Comparing these figures with those of 1904, the ore output decreased 59,580 short tons, gold decreased 2,032 ounces and $42,006 in value, silver increased 283 ounces and $1,315 in value, copper decreased 2,049,005 pound sand $234,876 in value, lead decreased 68,124 pounds and $2,439 in value.

Stanley Basin region.—The most important placer operations in the county were confined to Stanley Creek and to Joe's Gulch, in the same neighborhood. Wormack's dredge property, of the Stanley Dredging Company, was the only plant in operation, the other placer operators producing by means of hydraulics and sluicing.

Alder Creek district.—The White Knob Copper and Development Company, operating under the name of Macbeth Lease, has made a regular producer of the mine the past year, and kept its 500-ton copper matting furnace in blast during several months, cleaning up the accumulation of ores produced before the old management closed down the plant. The smelter was undergoing repairs preparatory to smelting the ore that is being steadily produced by the lessees.

Bayhorse district.—The Salmon River Mining Company develops its property by means of tunnels, the longest of which is 280 feet. Several shipments of silver ore were made to the railroad. The South Butte mine is also developed by tunnels aggregating about 800 feet in length. The property was in the hands of lessees and produced a good grade of lead-silver ore.

Yankee Fork district.—The Bismark and Daisy claims, owned by the Golden Sunbeam Mines Company, did mostly development work on the property, and took out some ore, which was treated in the plant equipped with 2 Elspass roller mills and amalgamation plates, which have a daily capacity of 50 tons of ore.

ELMORE COUNTY.

The output of the county for 1905 was contributed by 10 deep mines and from placers in 3 districts. The placer output was largely estimated by traders, who bought or handled it. The deep mines are credited with 11,226 short tons of ore, valued at $113,073, or a total average value of $10.07 per ton, which was entirely gold and silver. The placer yield amounted to gold 1,126 ounces, silver 186 ounces, valued together at $23,389, and making the total value of the county production $136,462. These figures compared with those for 1904 show that the ore tonnage increased 7,685 short tons in quantity and $44,443 in value; gold increased 3,147 fine ounces and $65,054 in value; silver, 1,466 fine ounces and $933 in value, a total increase for the metal output of $65,987 in value. Development work continues to be active on the best properties, and preparations are about completed, especially in the Atlanta section, that will put those mines among the regular producers.

Atlanta or Middle Boise district.—The Minerva Mining Company operated a stamp mill on ore taken out in development. This resulted in the shipment of some gold and silver bullion. The mine is developed by tunnels. One tunnel, after being driven 800 feet, encountered the ledge 200 feet below the old workings. The ore assays $19 to $20 in gold, with some silver. The Spears American Syndicate did some experimental work on the ores of the Tahoma mines in the milling plant on the property. The Washburn Milling Company operated a 20-stamp mill on ores from the Big Lode mine. The Jessie Benton mill was closed down for the purpose of putting in additional machinery. The Monarch and other properties owned by the Atlanta Mines Company are the most important in the district. An aerial tram has been ordered. This will be used to handle mine supplies for the present. A new road leading to Atlanta is being built by the people of the district.

Pine Grove district.—In this district important cyanide experiments which turned out successfully were made on ore of the Frankline mine. The 10-stamp mill on the property is now equipped to treat 100 tons of the sands per day after amalgamation. Tunnel work has been carried on in the mine on three different levels. On the second level a new ore body was opened in a crosscut driven eastward. The Provident Investment Company, which owns the Mountain View mine, is installing an electric power plant on Lime Creek for the operation of the Mountain View mill. The latter is ready for operation as soon as power is provided.

Warrior district.—During 1905 the White Ribbon mine and the Fourth of July claims were developed and tests made from both properties in a Kinkaid mill. The Rico-Mammoth mine, belonging to the New Century Mining Company, is being developed. The same company is installing 10-ton Kinkaid mills on their mines, referred to as the Upper and the Lower Queen's River groups, respectively 8 and 11 miles from Atlanta.

FREMONT COUNTY.

The Paymaster claim, located in Skull Canyon district, shipped a few tons of copper ore. The property is developed by a tunnel 275 feet long. The coal deposits near St. Anthony are continuing to attract attention and are likely to be included in the investigations to be made by the United States Geological Survey the coming year.

IDAHO COUNTY.

This county advanced during 1905 in the development of its mining industry. The main source of the precious metals is from quartz ores, but this production has decreased to the extent of 3,443 ounces of gold and 1,826 ounces of silver. The shortage of water caused the decrease and also affected the placer yield. During this enforced idleness the various companies owning placers were busy making important developments and providing reservoirs, which will in the future allow many operators a long season. Ten deep mines located in 7 different districts in 1904, and 15 deep mines in the same number of districts in 1905 contributed to the output of gold and silver, which is extracted from the ores largely by amalgamation, although one mine uses chlorination. The total tonnage of ore treated in the county amounted to 28,181 short tons, valued at $173,588, or an average value of $6.16 per ton. The placer producers numbered thirty, located in 8 different districts. The total output of the county is given as follows:

Production of gold and silver in Idaho County, Idaho, in 1904 and 1905.

Metal.	1904.		1905.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
DEEP MINES.						
Gold.....fine ounces..	11,697	$241,798	8,254	$170,625	−3,443	−$71,173
Silver.....do....	6,731	3,853	4,905	2,963	−1,826	− 890
PLACERS.						
Gold.....fine ounces..	2,887	59,680	2,289	47,318	− 598	− 12,362
Silver.....do....	29	17	254	153	+ 225	+ 136
Total.....	....	305,348	....	221,059	....	− 84,289

Production of ore in Idaho County, Idaho, in 1904 and 1905.

	1904.		1905.		Decrease, short tons.	Decrease per ton.
	Short tons.	Value per ton.	Short tons.	Value per ton.		
Ore output.....	36,367	$6.75	28,181	$6.16	8,186	$0.59

The origin of the precious metals by different kinds of ore is also indicated in the table above, as all the gold from the deep mines was derived from siliceous ores.

Dixie district.—The Seattle and Idaho Mining and Milling Company, operating the Comstock mine, carrying on development by shaft and tunnel, operated a 4-stamp mill and cyanide plant part of the year.

Elk City district.—This district, about 12 miles square, is destined to become an active mining camp. There are a number of quartz properties fairly developed, all showing good bodies of ore. Several stamp mills operated during the year. One of the producers attracting attention was Espey's South Fork group, located on the south fork of the Clearwater River, 8 miles west of Elk City. The ore produced came from near the surface, but development work by tunnel was started the last of the year. In a 2-stamp mill, operated by a gasoline engine, the free-gold ores were treated, while the high grade believed to contain tellurium was shipped to the Tacoma smelters. The placer producers all reported a shortage of water, on which account the output in the district was small.

Florence district.—The Bear Track claim is developed by a vertical shaft 100 feet deep. A 2-stamp prospect mill is located on the property, and testing is carried on during the development. The Gilt Edge Mining Company is developing by means of a 140-foot shaft. The property is equipped with a Merrall mill of 3 stamps.

Mărshall Lake district.—The operation of the Gold Bug placers was continued for a short time before the cold weather set in.

Newsome district.—After a very short run most of the placer operations were curtailed on account of the shortage of water. The Old Montana placer, belonging to the Sacajawea Exploitation Company, by storing water in a reservoir, accumulated a sufficient quantity to operate the hydraulic giants a few hours of each day. The Newsome and Leggett placers have been producing and undergoing extensive developments for the last two years. In their improved condition they will doubtless be important producers in the future. The gravel banks stand 800 feet above the Clearwater River, and are from 50 to 180 feet in perpendicular height. The Moose Creek Placer Company (Limited) operated in the same locality during the short season. A ditch 14 miles in length was completed, which, with other improvements, warrants the expectation of a larger yield during the current year. The Buffalo Hill placer was idle during the year, but will be producing in 1906. The Graham Ross Mining Company, owning the Anaconda claim, a quartz property 12 miles south of Newsome, erected during the year a 5-stamp mill equipped for amalgamation, which was put in operation during November. The Iron Crown mine was further developed, and the mill on the property was operated for testing purposes.

Oro Grande district.—This newly organized district was turned over to a local recorder in July. The boundary of the district extends from the mouth of Crooked River on Clearwater River, down the latter to the mouth of Twenty Mile Creek, thence southerly along the east line of the Robbins mining district to Fish Lake on Lake Creek, and down this creek two miles, where it turns east on a straight line to the Dixie divide between Big Creek and Crooked Creek, northerly along the divide between the head of Relief Creek and to the mouth of Crooked River. The Thunder Mountain Gold Company, in this district, owns 17 claims, including some placer ground, and a 5-stamp mill, which was operated a part of the year, while the water lasted. The mining property has been developed by tunnels and open cuts. Large deposits of low-grade ore with a reported average value of $2.50 per ton, are said to be exposed on this property, and from tests made can be mined and treated for $1.50 per ton. If the Crooked River Mining and Milling Company, operating the Hogan group of claims, finds its operations successful, it will be followed by other companies in operating low-grade gold properties. The cyanide mill of 250 tons daily capacity operated the latter part of the year, but the work done was largely experimental. The mine is worked by open raises connecting with the 600-foot tunnel. The ore is reported to average $3 per ton gold. A recent strike opened up a ledge of high-grade rock, in which the gold was visible. This necessitated the installation of amalgamation plates below the stamps.

Robbins or Buffalo Hump district.—The Atlas Mining Compay operated the 10-stamp mill a short time; but since it was found the mine needed further development, the plant was closed. The Cracker Jack Mining and Milling Company has been developing its property by a tunnel which is 901 feet long with upraises, and testing the ores extracted with a 10-stamp mill. The Jumbo Mining and Milling Company has its mine opened by 4 tunnel levels, gaining a depth of about 1,000 feet, with crosscuts and upraises aggregating 4,500 feet. The lower tunnel is to be used as the working tunnel, the portal of which is at the mill, which has 24 stamps and several concentrating tables. During the dry season there was only water power enough to operate from 10 to 20 stamps. The ore, treated by amalgamation, is principally quartz, but has some gold-bearing iron pyrite disseminated through it. The iron pyrite concentrated at the rate of 1 ton per day, is treated in a chlorination mill of 1 ton daily capacity. The North Star Mining and Milling Company recently started development work on the North Star group. A mill test on a small quantity of gold ore gave satisfactory results.

Simpson or Salmon River district.—Mining operations in this district are almost entirely confined to the placers on Salmon River, which are worked by tunneling and drifting under the bars and sluicing the gravels. The only quartz property operating, belonged to the McKinley Gold Mining and Milling Company. Two tunnels, the longer 775 feet long, constitute the development work. Some ore was tested in a prospecting mill, turning out bullion and concentrates.

Thunder Mountain district.—Considerable development work was performed on the properties in the district, but only one mine, the Dewey, owned by the Thunder Mountain Gold and Silver Mining Company, produced. The mill of 10 stamps, equipped for amalgamation, has averaged as high as 50 tons of ore per day a week at a time. The saving made has averaged fully 83 per cent of the assay value. The battery samples will average between $6 and $8 per ton. The Sunnyside mine, a neighbor of the Dewey, has done a large amount of development work and operated the mill of 30 stamps for a short period. New ore bodies have been opened up, averaging in thickness 22 feet of vein matter; most of it is said to average $10 per ton. A new mill using the cyanide process will in all probability be constructed next year.

Warren district.—The Silver King Gold Mining and Milling Company develops its mine by tunnels, of which it has three, the longest of which is 1,400 feet, with 2,000 feet of drifts. A 10-stamp mill equipped with amalgamation pans was operated and turned out some bullion. Production in the district was recorded from placer operations mainly. Important among the producers were the Grouse Creek placers, operated by the Golden Rule Placer Mining Company, the Shissler Creek Placer, the Lake Creek Gold Mining Company, the Rigdon Placer, and the Gott placers.

KOOTENAI COUNTY.

The most important event taking place in the county was the construction of the Panhandle smelter at Ponderay, Idaho, on the north shore of Lake Pend d'Oreille, about 60 miles east of Spokane, Wash. The building of this smelter is an incentive for increased mining operations in eastern Washington, northern Idaho, and western Montana, as well as in the immediate neighborhood. The ores produced in the county are argentiferous and auriferous lead, lead-zinc, and copper sulphides. The product produced during the year came from the Pend d'Oreille and Medimont districts, and was shipped to the Tacoma smelters. It will be possible to mine and ship to the Panhandle smelter $10 and $15 ores, as the freight rates will not exceed $1.50 per ton. The initial capacity of the plant will be 100 tons of lead ore daily. The Venezuela mine, at Lakeview, is part of the mineral holdings of the smelting company. The mine has large bodies of both siliceous and iron ores of excellent fluxing quality.

Camas Cove district.—About 18 miles from St. Marie is located the placer property of the Tyson Consolidated Gold Mining and Milling Company, at Tyson. The area of this camp is not as extensive as other districts, and while only development work has been carried on there has been produced from the placers previous to 1905 a total of over $500,000 in gold dust and nuggets. The mines are operated in a crude way without sufficient water to carry on the work. At present a hydraulic water system is being established at an expenditnre of $150,000, which will provide power and water.

LATAH COUNTY.

The output of this county, received entirely from placers, consisted of 225 ounces of gold, valued at $4,651, and 21 ounces of associated silver, valued at $13, a total value of $4,664. Seven operators contributed to the total, which was produced principally from the Gold Creek district. Hoodoo and Moscow districts also recorded production. The total value of the output was $1,393 less in 1905 than in 1904.

LEMHI COUNTY.

In this county considerable activity was manifested and more work was done than in the preceding year. Several small mines which were in operation in 1904 were idle in 1905, but at the larger mines more activity was displayed.

The Gilmore mine is proving a regular producer of lead-silver ore, and at the present time has the most important and largest ore bodies of the kind developed in the county. The ore is shipped 80 miles by wagon to the railroad. Mining development in the lime belt in the Gilmore region has been very active, and several lead properties will probably be added to the producers' list for 1906. Several mills are being constructed in the county. Among them is a 5-stamp mill on the Searchlight property, owned by the White Horse Company and located on Kirtley Creek. The mill of the Kittie Burton mine, one of the largest producers of gold, was destroyed by fire September 14. The plant will be rebuilt with an improved equipment. Another important property is owned by the Rabbitfoot Mining Company at Camp Ramey, on Silver Creek, where buildings for reduction works and a power plant are under construction. The output of the county for 1904 and 1905 is as follows:

Production of gold, silver, and associated metals in Lemhi County, Idaho, in 1904 and 1905.

Metal.	1904.		1905.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
DEEP MINES.						
Gold....fine ounces..	9,952	$205,726	3,309	$68,403	− 6,643	$137,323
Silver....do....	44,168	25,286	38,936	23,517	− 5,232	− 1,769
Copper....pounds..	5,000	625	....	....	− 5,000	− 625
Lead....do....	1,827,400	79,949	1,796,000	84,412	− 31,400	+ 4,463
PLACERS.						
Gold....fine ounces..	2,236	46,222	1,440	29,768	− 796	− 16,454
Silver....do....	307	176	421	255	+ 114	+ 79
Total....	....	357,984	....	206,355	....	− 151,629

Production of ore in Lemhi County, Idaho, in 1904 and 1905.

	1904.		1905.		Decrease.	Increase per ton.
	Short tons.	Value per ton.	Short tons.	Value per ton.	*Short tons.*	
Ore output....	31,746	$9.81	17,271	$10.21	14,475	$0.40

The origin of the precious metals by different kinds of ore is given in the table following:

Source of gold and silver in Lemhi County, Idaho, in 1904 and 1905, by kinds of ore.

[Fine ounces.]

Metal.	Year.	Placers.	Siliceous ore.	Lead ore.	Copper-lead ore.	Total.
Gold....	1904	2,236	9,860	66	26	12,188
	1905	1,440	3,239	70	....	4,749
Silver....	1904	307	92	41,076	3,000	44,475
	1905	421	336	38,600	....	39,357

Nine deep mines and 10 placers contributed in 1905 to this 1905 output, as against 16 deep mines and 15 placers in 1904. The total output of metals decreased mainly for the reason that a smaller number of deep mines produced in 1905, and the yield from placers was retarded by shortage of water. Although the total average value per ton shows an increase from $9.81 in 1904 to $10.21 in 1905, there was a decrease in the gold and silver content of the ores from $7.27 per ton in 1904 to $5.32 in 1905, or $1.95 per ton, which occurred principally with the gold in siliceous ores and with the silver in lead ores.

Eldorado district.—The White Horse Company, owning the Searchlight and Confidence claims, originally treated its ores in an arrastra. During the latter part of the year this company erected a 5-stamp mill, which is reported to be in successful operation.

Forney district.—From Ramey and Kane placers there were worked by hydraulic mining about 1,200 yards of gravel during the season. The gravel on these claims is from 6 to 8 feet deep on a soft bed rock.

Geertson Creek district.—The Last Chance and Eldorado claims operated a short time during the season. Very little gold was produced.

Gibbonsville district.—The placer output from this district, secured by hydraulic mining, continues to be the greatest from any region of the county. Development work was done on the Clara Morris quartz claims, and a little ore was extracted, which produced some concentrates and bullion. From the Gibbonsville group of claims, developed by a tunnel 3,000 feet long, the ore produced was treated in a 20-stamp mill, equipped for amalgamation and concentration.

Indian district.—The Kittie Burton Mines Company is the principal producer of precious metals in the district. Its mines are very extensively developed, the ores carrying gold from $5 to $7 per ton. The stamp mill was destroyed by fire in September. A new plant with improved equipment will be built. The property is located on Indian Creek, 6 miles from Salmon River and 30 miles from Salmon City.

Leesburg district.—The production of this region came altogether from the operation of placers, Richardson's placers leading, with the Nappias claims following. There were reports from several Chinese operators.

Mineral Hill district.—The Clipper Bullion mine, which is developed by tunnels from 300 to 600 feet long, operated its 5-stamp mill. The Pine Creek group of claims are developed by a tunnel to the extent of 1,000 feet. A 10-stamp mill is located on the property. The Boulder Creek Hydraulic Placer Mining Company is continuing to operate its gravel bars with good results.

Texas district.—The Gilmore Mining Company, the most prominent producer in the county, turned out a good grade of silver-lead ore, which is shipped 80 miles to the railroad station of Dubois on the Oregon Short Line Railway. The mine is developed by a shaft 300 feet deep, sunk from the end of a 300-foot tunnel level, which is 70 feet under the surface. A small jig plant and crusher operate on the lower grade ores and are capable of producing about 13 tons of concentrates per day. The Liberty Mining Company did mainly development work on its group of claims.

Yellow Jacket district.—Production is recorded from the placers in this district. Development work the past season has proven these placers to be very rich.

Parker Mountain district.—The new discoveries in this district have been extensively developed during 1905 by the United States Mining Company, of Salt Lake, and the Riebel syndicate. The ore is said to average about $30 per ton, its values being about two-thirds silver and one-third gold. A small trial shipment was made to the smelters by one of the operators.

LINCOLN COUNTY.

This county produced gold 156 fine ounces, silver 6 ounces, giving a total value of $3,229. The output came from placers located along Snake River.

NEZ PERCE COUNTY.

The total value of the mineral production of the county for 1905 is $25,129, of which the total placer yield was valued at $19,775.

Pierce district.—The Red Cloud group, located 8 miles southeast of Pierce City, did considerable development work and tested ore extracted from the mine in a 2-stamp plate amalgamation mill on the property. The mine is developed by a tunnel now 600 feet long. The Gateway Mining and Milling Company recently secured an option on the Wild Rose and a number of other mines which have been producers. The Wild Rose is developed by an inclined shaft 108 feet deep and provided with a 3-stamp mill. The Ozark Mining and Milling Company is operating 1½ miles east of Pierce City. A mill of 50-tons daily capacity will be erected to treat the ore by amalgamation and concentration and the sands by cyanide. Among the placer companies doing the greatest amount of development is the McClintock Mining Company, operating the Musselshell placers on a stream of that name, 12 miles east of Pierce City. Since the summer of 1904 the ground has been developed by driving open cuts and tunnels, and a ditch 6 miles long with a carrying capacity 1,000 miner's inches has been constructed. The Rich Hill Water and Mining Company, owning placers 1¼ miles northeast of Pierce City, operated its hill diggings by means of a pumping plant consisting of a 60-horsepower boiler and large duplex Worthington pump. The tests on black sands from this property gave such good results that much of the product will hereafter be saved for future treatment. During the year extensive tests were made of the City Park group of placers, consisting of 101 acres of ground at Pierce City. It was planned to erect during the spring months of 1906 a bucket dredge of 3,000 yards daily capacity, which was formerly in successful service in the Delta district of Shoshone County. Hundreds of acres of flat ground within this district are said to be suited for work by dredge.

Burnt Creek region.—A number of productive placers were operated as follows: Pick and Pan, Cranberry group, Upper Swamp Creek group, Boise claim by McGann Brothers, and the Daylight and Venus placers.

ONEIDA COUNTY.

The total output, valued at $8,133, was produced entirely from placer operations along Snake River in the vicinity of Neeley.

OWYHEE COUNTY.

This county continues to lead all counties of the State in its output of gold from deep mines, and also ranks as the greatest producer of both gold and silver from siliceous ores. Four deep mines and three placers yielded an output valued at $818,317. The deep mines produced 43,031 short tons of ore valued at $816,907, an average value of $18.98, which is entirely for the gold and silver contents. The total quantity of gold produced by deep mines was 14,798 ounces, valued at $305,902; silver, 846,035 ounces, valued at $511,005. The comparison of these figures for 1905 with those of 1904 shows that the ore decreased 16,005 short tons, and that its total value decreased $129,411. In 1904 the average value of the ore per ton was $16.02, but it increased in value to $18.98 in 1905, or $2.96 per ton. The decrease in the total tonnage of ore treated was caused principally by the suspension of milling operations while installing new equipment at the De Lamar property, one of the principal producers in the Carson district.

Carson district.—The De Lamar Company (Limited) has developed its property by tunnels, aggregating 32,000 feet. The old mill was closed down August 15, 1905, and preparations were made for installing a new plant with a capacity of 120 tons. The track taken up several years ago in the mill level tunnel is being relaid, and an upraise connecting the tunnel with the upper workings will be made. The Trade Dollar Consolidated Mining Company has opened up its mine to the northern or Florida Mountain end and has proved this portion to be as valuable as the other end, from which the largest quantity of ore has been taken in past years. The

Dewey tunnel, which develops the properties of this company at 1,700-foot depth, is 11,300 feet long, and all the product is handled through it by electric haulage. Employment is given to about 225 men in mine and mill. The ore is white quartz, containing the minerals chalcopyrite and argentite, and is treated by pan amalgamation in a 20-stamp mill equipped with vanners for concentration. Milling costs are $2.99 per ton, and the extraction of the precious metals is reported to be 93½ per cent. About two-thirds of the values are shipped to the smelter in the form of concentrates, while the remainder is produced as bullion. The Addie Consolidated Mining and Milling Company, with developments consisting of a 2,500-foot tunnel, operated its 5-stamp mill part of the year and shipped a small quantity of bullion. The Pioneer Mines Company, operating the Cumberland mine during the year, has kept 20 men working at the mine and mill. The plant is about to be connected with the Swan Falls power line running to Sinker tunnel. The mine is opened by an incline shaft on the vein, sunk 415 feet deep. The ore taken out in the development of the mine is treated by pan amalgamation in a 10-stamp mill.

War Eagle Mountain mines.—The Sinker Tunnel Company employed about 30 men during the year, and extended a raise several hundred feet in the direction of the old workings of the Golden Chariot mine, for the purpose of unwatering them, but it was found too dangerous to tap the great reservoir. The work has been abandoned until suitable pumping machinery can be put in operation from the surface. The tunnel was driven under War Eagle Mountain 6,350 feet to the Golden Chariot vein, cutting the vein at about 2,100 feet below the surface. The vein was drifted on 1,375 feet toward the Chariot shaft, where the upraise was started toward the old works and abandoned after 600 feet of work. Development work was done on the Banner property, which will probably be a producer in 1906, and the Potosi is to be opened up by a new company. The Commoner mine also changed hands and will be explored during the year. In the Flint and South Mountain districts interesting developments are occurring, and it seems likely that one or both of these districts will be added to the producing list.

SHOSHONE COUNTY.

At the time of the placer-mining excitement on the headwaters of the Cœur d'Alene River in 1883 rich quartz lodes were found to exist on Pritchard and Eagle creeks. The first silver-lead ore is stated to have been found during 1883, near the head of Beaver Creek. Since the time the first discoveries were made many changes have taken place. The value of the gold produced was maintained and increased for a number of years, but was eventually superseded by the values in silver and lead. The production of the latter metal is greater now than that of any other district in the United States. During 1885 two mills were built in the gold regions. In 1886 Wardner camp became a producer, large concentrating works were constructed, and the Northern Pacific built a branch railroad. In 1898 the placers of the Cœur d'Alene district were practically exhausted, the hydraulic method of operation being superseded by dredges, which have worked large areas of lean ground left by the miners of the past generation, for the reason that the ground would not pay at that time.[a] Since 1904 one of the two dredges working near Murray was moved to the Pierce district, in Nez Perce County.

Previous to the year 1904 the mining region in the southern part of the county on the north fork of the Clearwater River, that on the headwaters of Orofino Creek, and camps Orofino, Dent, and Pierce were part of Shoshone County. These deposits were discovered in 1860. During 1904 the division line between Nez Perce and Shoshone counties was readjusted and a portion of the county annexed to Nez Perce County. The Coeur d'Alene mining region of this county is the largest producer of

[a] Reports of the Director of the Mint, 1883 to 1898.

silver-lead ore in the United States. The total output of silver and lead from deep mines is valued at $16,335,979, which is $2,968,035 greater than the output of 1904. The year 1905 has to its credit 8 new silver-lead producers, whose operations have greatly increased the proved mineral area of the district. Development work at deeper levels by the larger companies and the increase of the output are features of the year. The production of the county for 1904 and 1905 is given in the table following:

Production of gold, silver, and associated metals in Shoshone County, Idaho, in 1904 and 1905.

Metals.	1904.		1905.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
DEEP MINES.						
Gold............fine ounces..	1,001	$20,693	246	$5,085	− 755	− $15,608
Silver ....do....	6,143,001	3,516,868	7,292,655	4,404,763	+ 1,149,654	+ 887,895
Copper ....pounds..	1,424,440	178,055	5,225,606	815,194	+ 3,801,166	+ 637,139
Lead ....do....	225,167,443	9,851,076	253,855,662	11,931,216	+28,688,219	+2,080,140
Zinc ....do....	....	....	144,000	8,496	+ 144,000	+ 8,496
PLACER MINES.						
Gold............fine ounces..	1,225	25,322	1,640	33,902	+ 415	+ 8,580
Silver ....do....	....	....	331	200	+ 331	+ 200
Total....................	....	13,592,014	....	17,198,856	....	+3,606,842

Production of ore in Shoshone County, Idaho, 1904 and 1905.

	1904.		1905.		Increase.	
	Short tons.	Value per ton.	Short tons.	Value per ton.	Short tons.	Value per ton.
Ore output..........................	1,410,245	$9.62	1,526,927	$11.24	116,682	$1.62

The origin of the precious metals by different kinds of ore is given in the following table:

Source of gold and silver in Shoshone County, Idaho, 1904 and 1905, by kinds of ore.

[Fine ounces.]

Metal.	Year.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Copper-lead ore.	Lead-zinc ore.	Total.
Gold	1904	1,225	1,001	....	....	....	....	2,226
	1905	1,640	....	246	....	....	....	1,886
Silver	1904	....	....	106,833	6,036,168	....	....	6,143,001
	1905	331	....	390,000	6,891,344	5,894	5,417	7,292,986

In 1905 there were 27 deep mines and 10 placers; in 1904 only 19 deep mines and 8 placers produced. With this increase in the number of operating properties it is natural that the increase was general in all classes of mining, as is shown in the table above. The siliceous gold ore production in 1904 came from the Murray region; but in 1905 the properties were developing and no production was reported. Some gold was produced from copper ores. This source was also responsible for the heavy yield of silver, which increased on account of the greater tonnage produced over the previous year, and for a like reason silver in lead ores increased. Future increase in production of copper-lead ore carrying silver may be expected, and likewise in the lead-zinc ores. In the total ore product lead concentrates amounting to 179,497 short tons were reported by 17 operators; the silver output was valued at $3,012,976, or an average value of $16.79 per ton; no gold was reported. Tailings in the creek beds were treated by 4 operators, who reported the treatment of 6,620 short tons, which yielded lead concentrates containing silver amounting to $5,372, or $0.81 per ton.

The list of mines in Shoshone County numbers 170 names, 37 of which were producing mines in 1905; 24 of the number are lead mines, 2 copper mines, 1 zinc mine, and 10 placers, which are classified as 8 hydraulic, 1 drift, and 1 dredge. The principal mining districts or camps are Lelande, Yreka, Hunter, Summit, Evolution, Placer Center, St. Regis, Beaver, and Eagle. A brief review of the districts, giving sources of production, follows:

Beaver district.—At Delta, in this district, dredging operations were carried on by the Mascot Gold Mining Company for about three months. Other operators produced by sluicing. At Thiard some drift mining was carried on. The total placer yield was valued at $16,411.

Eagle district.—This district produced $9,796 in placer gold, which came from Eagle Creek and tributaries by sluicing operations.

Evolution district.—No new developments were reported from this district. The only producer was the Yankee mine, which made several shipments of silver-lead ore carrying copper.

Hunter district.—The Gold Hunter Mining and Milling Company has its mine developed by a tunnel 1,800 feet long and a shaft 200 feet below tunnel level. A new tunnel is to be run to tap the ore bodies on a level with the mill. The capacity of the mill which is equipped with concentrators is 350 tons per day. The Morning and You Like mines were purchased by the Federal Mining and Smelting Company, which took them in hand on September 1, 1905. The mine is equipped with a narrow-gage railroad and a concentration mill of 1,000 tons daily capacity. The most important development at the mine during the year was the completion of the No. 6 tunnel, which is driven a distance of 2 miles. The Snowstorm Mining Company, reporting from this district, has its mine developed by tunnels to a depth of over 1,200 feet. The production of siliceous, copper, and silver-bearing ore from this property has gone on regularly, the shipments being made to Butte and Anaconda, Mont., and to Tacoma, Wash. The leaching plant of 200 tons capacity, erected by the lessees of a portion of this property, was completed but was not operated any considerable length of time. The Monitor Consolidated Mining Company, another copper producer, located southeast of the Snowstorm, reports from the St. Regis district. The property is developed by a 300-foot vertical shaft, and shipped to Tacoma ore which contained some gold and silver with the copper.

Lelande district.—The Federal Mining and Smelting Company continues to be the most extensive operator in the county, and, besides its Morning and You Like mines at Mullan in the Hunter district and the Last Chance mine at Wardner in Yreka district, it operates the Tiger-Poorman and the Empire State mines at Burke, and the Standard-Mammoth mine at Mace in this district. The Burke mines are developed by a shaft 2,000 feet deep. A 600-ton concentration plant treats the ores. The Mace mines are developed by a tunnel 3,000 feet long and a shaft 1,050 feet deep. The ores are treated in a concentration plant of 1,050 tons daily capacity. At Burke the Hercules Mining Company develops its mine by four tunnels, three of which have opened the vein. The fourth has not yet been completed. The ore produced is shipped directly to the smelters and the milling ore is stored on dumps or in stopes awaiting the completion of the mill, which will greatly increase the mine's output in 1906. The Tamarack and Chesapeake mine, located in Nine-Mile Canyon, is a new producer, developed by tunnels to a depth of 300 feet, with 6 feet of clean shipping lead-silver ore. At Gem the Frisco, the Gem, and the Black Bear mines, all adjoining and consolidated under the name of the Frisco mine, are owned and operated by the Frisco Mining Company (Limited). Mining was not carried on by the company during 1905, but production was made by lessees. The mine is developed by several tunnels and a vertical shaft 1,400 feet deep below the lowest tunnel level. A wet concentration plant of 600 tons daily capacity is located on the property. The Hecla Mining Company at Burke has its working shaft 900 feet deep, with drifts to the ore body 750 feet. A 300-ton concentrator was operated and turned out concentrates regularly during the year. The 16 to 1 mine, operated by the Rex Mining Company, is another new producer. This property was in litigation for a number of years. The mine, which is equipped with a 250-ton concentration mill, has been under lease during the year to one of the owners.

Placer Center district.—The Granite mine, an old property, was again brought to the producing stage during the year by the Success Mining Company. This mine was operated a number of years ago, but the ore carried large quantities of zinc, which was detrimental then, but which now finds a ready market. The company has the only mill in the county that makes a separation of lead and zinc. The capacity of the plant is about 150 tons crude ore per day. The zinc concentrates are shipped to the Kansas smelters. The Pittsburg Lead Mining Company has placed the Black Cloud and the California mines among the producers during the year. The mines are developed by tunnels and a 250-ton concentration plant is operated. Eighty men are employed in mine and mill.

Summit district.—This district, with Murray as its main camp, located at the headwaters of the Cœur d'Alene River, is the pioneer district of the county, and has been a steady producer of gold since 1884. From that year until 1895 the gold production steadily increased and from 1895 to 1905 as steadily decreased. In addition to its gold, the district had a large production of lead-silver ore during the year. A wagon haul of 23 miles is required to get the ore to the railroad. The Black Horse, the Rialto, and other claims, operated by the Idaho-Montana Summit Mining Company, are opened by a tunnel. Large bodies of high-grade ore are said to have been opened near the surface, and several shipments were made. The Monarch Mining Company, with development work consisting of a shaft 90 feet deep and tunnels aggregating 4,985 feet, reaches a total vertical depth of 1,400 feet by its lowest tunnel. Its concentration mill is of 75 tons daily capacity and was operated two months of the year. The Bear Top Mining Company during development work of its mine by tunnel turned out a good product through its concentrator. The Cœur d'Alene Mining Company, as well as a number of smaller hydraulic operators, produced gold from placers in the district during the year. The production as recorded shows gold, 372 ounces; silver, 5,527 ounces, and lead, 843,768 pounds. The total value of the production was $50,686.

Yreka district.—At Wardner, the main camp, the Federal Mining and Smelting Company and the Bunker Hill and Sullivan Mining Company are the largest producers. The most important event was the completion of the Bunker Hill's 2-mile Kellogg tunnel. This tunnel has developed immense ore bodies and has proved them to exist at greater depth then hitherto explored. Most of the ore is shipped direct to the smelters without milling. The opening of the Senator Stewart mine, the Highland Chief, and the Silver King claims were important events, each property making shipments of lead ore. The operation of jigging plants on tailings which have lodged in the creeks continues to be a source of profit. The value of the year's output of concentrates from tailings for the silver and lead contents was reported to be $22,848.

WASHINGTON COUNTY.

The extension of the Pacific and Idaho Northern Railway, which was under construction during the year from Council to Meadows, is most important to the mining interests in the Seven Devils, the Warren, and the Thunder Mountain regions. From the operations during 1905 of three producers—a decrease of three from preceding year—there were 6,773 short tons of ore shipped and treated, valued at $283,749, an average value of $41.89 per ton. The total quantity of gold produced from the ore was 1,449 ounces, valued at $29,953; silver, 57,700 ounces, valued at $34,851, and copper, 1,403,493 pounds, valued at $218,945. A comparison of these figures for 1905 with those for 1904 shows that the tonnage decreased 1,957 tons and that its total value increased $87,819. In 1904 the average value per ton was $22.44, which increased to $41.89, or $19.45 per ton. The gold and silver value was $9.58 per ton in 1904 and $9.57 in 1905. During 1904 some of the lower-grade copper-bearing ores were mined and reduced to matte in the Washington and the Seven Devils districts, while in 1905 the ore carried a much higher per cent of copper and was shipped directly from the mines to the smelters at Sumpter, Oreg., and Salt Lake, Utah. The total quantity of gold produced in the county decreased 689 ounces and $14,242 in value; silver, 12,664 ounces and $5,432 in value; copper increased 505,284 pounds and $106,669 in value. Included in the total quantity of metal produced is placer gold and silver bullion sent to the mint, valued at $726, which came from Meadows and the Seven Devils district.

Black Lake district.—The Idaho Gold Coin Mining and Milling Company started a crosscut tunnel, which will be 1,200 feet long and will tap the ore body about 500 feet below its present lowest level. The new 50-ton cyanide mill on the property was started and ran a short time, but was then closed down until spring.

Seven Devils district.—The Peacock group of claims produced ore taken out by lessees. The ore was tested at Landore, and other shipments of higher grade were made to the Sumpter, Oreg., and the Salt Lake smelters. The Ladd Metals Company also made a number of shipments from properties under its control.

Meadows district.—Four miles from Meadows, on Goose Creek, are located the Rock Flat placers, which produced in doing development work. In working 3,000 cubic yards of material the operators are reported to have saved about $600 in gold. The formation from which this gold was taken appears to be a mass of altered igneous rock which is very soft. It may be possible to work the deposit with hydraulic giants. A 600-foot tunnel has been contracted for, to run through the point of a hill. When the tunnel is finished the débris from placer operations can be readily handled.

Snake River district.—Considerable interest is taken in dredging operations at Olds Ferry, 8 miles below Weiser. At this point there is a tract of about 2,000 acres surfaced with shifting sands of various depths, which carry the values. A dredge of 3,000 yards daily capacity is under construction by the Idaho Placer Mining Company.

MONTANA.

By Alexander N. Winchell.

PRODUCTION.

The reports received by the United States Geological Survey from the producers show that the gold production of Montana during 1905 was 231,913.75 ounces, valued at $4,794,083, and the silver, 13,231,300 ounces, valued at $7,991,705. The State produced 304,723,526 pounds of copper, valued at $47,536,870, and 6,264,998 pounds of lead, valued at $294,455. For the first time Montana also produced zinc on a commercial basis, the output during the year amounting to 1,560,000 pounds, valued at $92,040.

The production of metals during 1905 in Montana may be compared with that of the preceding year as follows:

Production of gold, silver, and associated metals in Montana in 1904 and 1905.

	1904.		1905.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	206,419.45	$4,267,062	231,913.75	$4,794,083	+25,494.30	+$527,021
Silver ....do....	12,817,285	7,334,146	13,231,300	7,991,705	+414,015	+657,559
Copper ......pounds..	290,681,572	37,274,097	304,723,526	47,536,870	+14,041,954	+10,262,773
Lead ....do....	2,299,291	99,076	6,264,998	294,455	+3,965,707	+195,379
Zinc ....do....	....	....	1,560,000	92,040	+1,560,000	+92,040
Total............	....	48,974,381	....	60,709,153	....	+11,734,772

Mining conditions in the State as a whole were satisfactory during 1905, and all the metals show increases in production as compared with 1904. The increase of gold amounted to 25,494.30 fine ounces, valued at $527,021, or 12 per cent. The increase of silver amounted to 414,015 fine ounces, or only 3 per cent; but on account of a higher average price for silver the value increased $657,559, or 9 per cent. The production of copper was greater than ever before in the history of the State, and for this reason, as well as on account of the high price of copper and silver, the total commercial value of the entire metallic product for the year was considerably greater than that recorded in any previous year.[a]

Considering the production more in detail, the various counties of the State contributed to the total output of metals won during the year in the varying quantities shown in the following table. In this table, and in others which follow, Chouteau, Meagher, and Ravalli counties are put in one group and Deer Lodge and Flathead counties in another group to avoid disclosing the output of individual companies.

Production of gold, silver, copper, lead, and zinc in Montana in 1905, by counties.

County.	Gold.				Silver.	
	Placer.		Deep mines.			
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*		*Fine ounces.*	
Beaverhead............	35.31	$730	78.00	$1,613	48,145	$29,079
Broadwater............	238.15	4,923	5,547.44	114,676	58,627	35,411
Cascade............	....	....	183.18	3,787	415,708	251,088
Chouteau, Meagher, and Ravalli..........	194.68	4,024	7,539.07	155,846	5,962	3,600
Deer Lodge and Flathead............	682.04	14,099	8,739.94	180,670	37,759	22,807
Fergus............	....	....	60,719.80	1,255,190	3,369	2,035
Granite............	135.40	2,799	7,217.95	149,208	718,271	433,836
Jefferson............	289.59	5,986	8,475.86	175,212	434,138	262,219
Lewis and Clark.......	574.39	11,874	26,929.75	556,687	153,590	92,768
Madison............	13,122.13	271,258	22,065.62	456,137	137,840	83,255
Missoula............	2,067.26	42,734	141.50	2,925	5,023	3,035
Park............	278.83	5,764	2,170.07	44,859	840	507
Powell............	1,471.97	30,429	1,764.62	36,478	21,012	12,692
Silver Bow............	110.32	2,281	61,140.88	1,263,894	11,191,016	6,759,373
Total............	19,200.07	396,901	212,713.68	4,397,182	13,231,300	7,991,705

[a] In regard to the lead production it should be stated that it has proved impossible to obtain complete data from the mines. The total returns from the mines for 1905 amount to 4,373,998 pounds of lead. It is known from smelter returns that 6,264,998 pounds were actually produced, and this quantity has been distributed in proper proportion among the counties. The returns from a complete mine list are thus 1,891,000 pounds less than the actual output as reported by the smelters.—Note by W. Lindgren.

Production of gold, silver, copper, lead, and zinc in Montana in 1905, etc.—Cont'd.

County.	Copper.		Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Pounds.*		
Beaverhead	109,009	$17,005	177,600	$8,347	....	....	$56,774
Broadwater	49,647	7,745	656,606	30,861	....	....	193,616
Cascade	....	....	747,686	35,141	....	....	290,016
Chouteau, Meagher, and Ravalli	....	....	....	....	....	....	163,470
Deer Lodge and Flathead	....	....	1,462,881	68,756	....	....	286,332
Fergus	....	....	10,000	470	....	....	1,257,695
Granite	6,144	959	38,687	1,818	....	....	588,620
Jefferson	174,073	27,155	1,081,817	50,846	....	....	521,418
Lewis and Clark	5,705	890	205,283	9,648	....	....	671,867
Madison	25,437	3,968	466,828	21,941	....	....	836,559
Missoula	45,086	7,034	31,516	1,481	....	....	57,209
Park	....	....	....	....	....	....	51,130
Powell	532	83	245,428	11,535	....	....	91,217
Silver Bow	304,307,893	47,472,031	1,140,666	53,611	1,560,000	$92,040	55,643,230
Total	304,723,526	47,536,870	6,264,998	294,455	1,560,000	92,040	60,709,153

On account of a steady increase in the output of auriferous copper ores and other gold ores in Silver Bow County and a slight decrease in the gold production of Fergus County, the former county this year takes first rank in the production of gold. These two counties together produce more than half of the gold output of the State. Silver Bow County easily leads in the production of silver and copper, its output amounting to 84.6 per cent of the total silver and to 99.9 per cent of the total copper. Granite County still holds second rank in the production of silver, in spite of a notable decrease in its output. Beaverhead County yields second place as a copper producer to Jefferson County, which shows a very large percentage of increase in its copper record. Flathead County leads in the production of lead, with Silver Bow County second, and Jefferson County a close third. Zinc is produced only in Silver Bow County.

Some of these changes are shown in the following table, which gives the increases and decreases in the production of metals in the various counties during the year compared with 1904.

Increase (+) and decrease (−) in production of metals in Montana in 1905 compared with 1904.

County.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*		*Pounds.*	
Beaverhead	− 338.64	− $7,000	− 11,725	− $5,179	− 434,117	− $52,640
Broadwater	+ 3,902.99	+ 80,682	+ 16,396	+ 11,244	+ 49,647	+ 7,745
Cascade	+ 176.93	+ 3,658	+211,134	+134,029	....	....
Chouteau, Meagher, and Ravalli	+ 1,739.90	+ 35,967	− 2,211	− 1,076	− 75,000	− 9,617
Deer Lodge and Flathead	+ 996.13	+ 20,592	+ 14,834	+ 9,690	....	....
Fergus	− 448.70	− 9,273	+ 1,850	+ 1,196	....	....
Granite	+ 3,022.25	+ 62,475	−575,025	−306,200	+ 6,144	+ 959
Jefferson	+ 1,563.05	+ 32,311	+103,047	+ 72,765	+ 162,973	+ 25,732

Increase (+) and decrease (—) in production of metals in Montana in 1905 compared with 1904—Continued.

County.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Lewis and Clark	— 1,933.61	—$39,970	— 23,899	— $8,793	— 1,362	— $16
Madison	+ 3,802.55	+ 78,606	+ 12,351	+ 11,449	+ 14,137	+ 2,519
Missoula	+ 344.26	+ 7,116	+ 4,978	+ 3,010	+ 45,086	+ 7,034
Park	— 624.10	— 12,901	— 2,493	— 1,400	....	....
Powell	— 985.51	— 20,371	+ 4,344	+ 3,155	— 468	— 45
Silver Bow	+14,276.80	+295,129	+660,434	+733,669	+14,274,914	+10,281,102
Total	+25,494.30	+527,021	+414,015	+657,559	+14,041,954	+10,262,773

County.	Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
Beaverhead	+ 70,519	+ $3,733	....	....	— $61,086
Broadwater	+ 360,857	+ 18,118	....	....	+ 117,789
Cascade	+ 29,378	+ 4,189	....	....	+ 141,876
Chouteau, Meagher, and Ravalli	....	....	....	....	+ 25,274
Deer Lodge and Flathead	+ 915,012	+ 45,148	....	....	+ 75,430
Fergus	+ 10,000	+ 470	....	....	— 7,607
Granite	+ 38,687	+ 1,818	....	....	— 240,948
Jefferson	+ 680,302	+ 33,545	....	....	+ 164,353
Lewis and Clark	+ 169,595	+ 8,110	....	....	— 40,669
Madison	+ 280,947	+ 13,931	....	....	+ 106,505
Missoula	+ 31,516	+ 1,481	....	....	+ 18,641
Park	....	....	....	....	— 14,301
Powell	+ 238,228	+ 11,225	....	....	— 6,036
Silver Bow	+1,140,666	+ 53,611	+1,560,000	+$92,040	+11,455,551
Total	+3,965,707	+195,379	+1,560,000	+ 92,040	+11,734,772

It will be seen by this table that increase in metallic production is quite general in all parts of the State. Beaverhead and Lewis and Clark counties show increases only in lead production; Park County shows no increase; Granite County has a large decrease in silver, but an increased production of gold, copper, and lead; Powell County shows a decrease in gold and copper, but in silver and lead an increase is reported. The copper product of Meagher County has decreased, and also the silver product from the group including that county, but the gold shows a distinct increase. Fergus County has a small decrease in gold output, but an increase in silver and lead. Broadwater, Cascade, Deerlodge, Flathead, Jefferson, Madison, Missoula, and Silverbow counties report increased production of all their metals.

The number of producing deep mines has also increased notably in practically all parts of the State. The same is true of the total tonnage of ore sold or treated from the various counties. On the other hand, the changes in the average total value per ton and in the average value per ton in gold and silver commonly prove to be decreases, although the totals for the State show small increases on account of the increases in Silverbow County. These facts are shown in the table which follows.

Tonnage of ore sold or treated, number of mines producing, and tenor of ores in Montana in 1904 and 1905, by counties.

County.	Total tons of ore sold or treated.		Mines producing.		Average value per ton.		Average value per ton in gold and silver.	
	1905.	Increase (+) or decrease (−).	1904.	1905.	1904.	1905.	1904.	1905.
	Short tons.	*Short tons.*						
Beaverhead	1,320	− 11,250	4	5	$9.15	$42.46	$3.24	$23.25
Broadwater	10,516	+ 9,166	8	19	45.63	17.94	36.19	14.27
Cascade	11,951	+ 9,680	4	6	65.23	24.27	51.60	21.33
Chouteau, Meagher, and Ravalli	45,600	+ 19,036	3	2	4.52	3.50	4.16	3.50
Deerlodge and Flathead	31,400	− 3,282	4	3	5.47	8.67	4.79	6.48
Fergus	224,273	− 69	5	5	5.64	5.61	5.64	5.61
Granite	28,156	− 5,543	10	19	24.11	20.81	24.11	20.71
Jefferson	34,434	+ 57	15	39	10.34	14.97	9.80	12.70
Lewis and Clark	151,655	+ 24,825	9	24	5.51	4.35	5.49	4.28
Madison	49,204	+ 11,002	28	55	11.81	11.46	11.56	10.94
Missoula	660	+ 660	0	4	....	21.85	....	8.95
Park	4,021	+ 1,539	2	3	25.78	11.28	25.78	11.28
Powell	7,647	+ 4,528	8	10	25.55	7.94	25.42	6.42
Silverbow	4,419,300	+316,696	37	60	10.77	12.59	1.71	1.82
Total	5,020,137	+377,045	137	254	10.46	12.01	2.41	2.47

The tonnage of ore, with its value, the quantity of concentrates produced and the value thereof, together with the quantity of old tailings treated and their value, are shown in the following table. The largest quantity of old tailings was treated in Lewis and Clark County, while the ores of Silver Bow County served to produce by far the greatest quantity of concentrates.

Tonnage and value of ore, concentrates, and old tailings in Montana in 1905, by counties.
[Short tons.]

County.	Total ore.		Concentrates produced.		Old tailings treated.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Beaverhead	1,320	$56,042	7	$140	....	....
Broadwater	10,516	188,670	297	3,464	....	....
Cascade	11,951	290,016	....	....	....	....
Chouteau, Meagher, and Ravalli	45,600	159,432	....	....	....	....
Deer Lodge and Flathead	31,400	272,198	1,685	30,124	....	....
Fergus	224,273	1,257,695	1	2,608	....	....
Granite	28,156	585,812	....	....	1,291	$8,291
Jefferson	34,434	515,399	1,939	45,455	640	8,341
Lewis and Clark	151,655	659,942	427	21,647	82,659	162,754
Madison	49,204	564,102	2,882	142,641	235	2,790
Missoula	660	14,420	....	....	....	....
Park	4,021	45,341	....	....	....	....
Powell	7,647	60,693	701	29,100	....	....
Silver Bow	4,419,300	55,640,936	1,223,632	5,301,042	11,890	45,937
Total	5,020,137	60,310,698	1,231,571	5,576,221	96,715	228,113

There were 332 mines of all classes that reported a production during 1905; of these 78 were placer mines, including 5 dredging placers and 1 drift placer. Of the 254 deep mines gold was the chief product of 127, silver of 68, copper of 48, and lead of 11. The distribution of these mines, by counties, is shown in the following table:

Number of mines classified by chief product in Montana in 1905, by counties.

County.	Non-producing mines.	Gold placer mines. Hydraulic.	Drift.	Dredge.	Total.	Deep mines. Gold.	Silver.	Copper.	Lead.	Total.	Mines reporting product.
Beaverhead	16	1			1	1	3	1		5	6
Broadwater	11	4			4	13	3	1	2	19	23
Cascade	2						6			6	6
Chouteau, Meagher, and Ravalli	12	3			3	2				2	5
Deer Lodge and Flathead	19	5			5	2			1	3	8
Fergus	6					5				5	5
Granite	21	7			7	11	7	1		19	26
Jefferson	17	3		1	4	12	21	3	3	39	43
Lewis and Clark	18	21			21	19	4		1	24	45
Madison	23	10		1	11	49	3		3	55	66
Missouli	16	8			8	1	1	2		4	12
Park	6	1	1	1	3	3				3	6
Powell	10	8		2	10	9			1	10	20
Silver Bow	21	1			1		20	40		60	61
Total	198	72	1	5	78	127	68	48	11	254	332

The gold won during the year was obtained from various sources, as shown in the following table. Nearly two-thirds of the gold was obtained from siliceous ores, more than 20 per cent from copper ores, and nearly 10 per cent from placer mines. Madison County is the source of two-thirds of the placer gold. Fergus County leads in the production of gold from siliceous ores, with Lewis and Clark County second and Madison County third. The gold from copper ores is of course nearly all from Silver Bow County, which also produced some gold from a complex ore containing gold, silver, lead, zinc, and copper.

Compared with the production of 1904 the placer gold shows a slight decrease, while the gold obtained from lead ores increased by more than 100 per cent. In the other classes the gold shows a normal increase.

Source of gold product in Montana by kinds of ore in 1905, by counties.

[Fine ounces.]

County.	Placers.	Deep mines. Siliceous ores.	Copper ores.	Lead ores.	Copper-lead-zinc ores.	Total.	Total.
Beaverhead	35.31	72.60	6.00			78.00	113.31
Broadwater	238.15	4,608.49		938.95		5,547.44	5,785.59
Cascade		161.18		22.00		183.18	183.18
Chouteau, Meagher, and Ravalli	194.68	7,539.07				7,539.07	7,733.75
Deer Lodge and Flathead	682.04	8,202.00		537.94		8,739.94	9,421.98
Fergus		60,719.80				60,719.80	60,719.80
Granite	135.40	7,197.73	.22	20.00		7,217.95	7,353.35
Jefferson	289.59	7,723.36	6.00	745.30	1.20	8,475.86	8,765.45
Lewis and Clark	574.39	26,759.72	120.93	49.10		26,929.75	27,504.14
Madison	13,122.13	21,158.49	19.35	887.78		22,065.62	35,187.75
Missoula	2,067.26	100.00	41.50			141.50	2,208.76
Park	278.83	2,170.07				2,170.07	2,448.90
Powell	1,471.97	66.59		1,698.03		1,764.62	3,236.59
Silver Bow	110.32	8,314.44	52,687.44		139.00	61,140.88	61,251.20
Total	19,200.07	154,792.94	52,881.44	4,899.10	140.20	212,713.68	231,913.75
Increase (+), decrease (−)	−1,366.38	+15,510.94	+8,441.14	+2,768.40	+140.20	+26,860.68	+25,494.30

The source of the silver won during the year in Montana by kinds of ore is shown in the following table. About 80 per cent was derived as a by-product in the treatment of copper ores, nearly 6 per cent came from lead ores, and a little less than 14 per cent came from gold-silver siliceous ores. A small quantity was derived from a complex ore containing gold, silver, copper, lead, and zinc. Granite County was the chief producer of silver from siliceous ores, with Silverbow County second. The latter county produced nearly all the silver from copper ores. Cascade County leads in the production of silver from lead ores, with Jefferson County second.

Compared with 1904 the silver from siliceous ores show a marked decrease, due to the decrease in Granite County. The silver from lead ores shows an increase of more than 70 per cent, due chiefly to the increase in Cascade and Jefferson counties.

Source of silver product in Montana by kinds of ore in 1905, by counties.

[Fine ounces.]

County.	Placers.	Deep mines.					Total.
		Siliceous ores.	Copper ores.	Lead ores.	Copper-lead-zinc ores.	Total.	
Beaverhead	4	7,200	2,160	38,781		48,141	48,145
Broadwater	38	24,371		34,218		58,589	58,627
Cascade		34,196		381,512		415,708	415,708
Chouteau, Meagher, and Ravalli	23	5,939				5,939	5,962
Deerlodge and Flathead	58	6,237		31,464		37,701	37,759
Fergus		3,369				3,369	3,369
Granite	14	705,436	821	12,000		718,257	718,271
Jefferson	55	180,244	2,544	250,339	956	434,083	434,138
Lewis and Clark	85	147,215	828	5,462		153,505	153,590
Madison	1,985	111,047	66	24,742		135,855	137,840
Missoula	90	1,438	3,495			4,933	5,023
Park	42	798				798	840
Powell	157	518		20,337		20,855	21,012
Silverbow	22	569,714	10,614,680		6,600	11,190,994	11,191,016
Total	2,573	1,797,722	10,624,594	798,855	7,556	13,228,727	13,231,300
Increase (+) or decrease (−)	+2,246	−318,681	+388,475	+334,419	+7,556	+411,769	+414,015

The following statements give the rank of the most important counties of the State in the production of gold and silver in 1905: Silverbow, Fergus, Madison, and Powell are the leading counties of the various classes of gold production, and Silverbow, Granite, Cascade, and Madison lead in the production of silver from various sources. Placer gold: Madison, Missoula, Powell. Gold from siliceous ores: Fergus, Lewis and Clark, Madison, Silverbow. Gold from copper ores: Silverbow, Lewis and Clark, Missoula, Madison. Gold from lead ores: Powell, Broadwater, Madison, Jefferson.

Silver from siliceous ores: Granite, Silverbow, Jefferson, Lewis and Clark, Madison. Silver from copper ores: Silverbow, Missoula, Jefferson. Silver from lead ores: Cascade, Jefferson, Beaverhead.

The chief cause of the increased output of metals during 1905 was the high price obtainable for them during the whole year. As the prices are maintaining their range, the prospect for an increased production in 1906 is excellent. In fact, several companies organized in 1905 are already producing. The greatest activity naturally centers in Butte, the chief mining district of the State, but it is also notable in Jefferson, Beaverhead, Broadwater, Madison, and other counties.

REVIEW BY INDIVIDUAL COUNTIES.

BEAVERHEAD COUNTY.

There was not much activity in mining in Beaverhead County during 1905, though the county has been an important producer of metals for years, first as a placer field and then as a silver-lead district, with subordinate gold and copper. During 1905 the placers were nearly all idle, and the property of the Hecla Company, which has produced continuously for twenty years, was only worked in a small way by lessees. Development work was carried on by the Washoe Copper Company at the Indian Queen mine, and some high-grade copper ore was sent to the smelter. A 10-stamp mill was built at the Ajax mine, near Wisdom. At the Polaris mine preparations are made to install a 100-ton smelter.

BROADWATER COUNTY.

The production of Broadwater County shows a large increase in all the metals in 1905. The chief districts in the county are Beaver Creek near Winston, and Cedar Plains near Radersburg. There is considerable activity also in the Park district near Hassel.

Metallic production of Broadwater County, Mont., in 1904 and 1905.

Year.	Gold.		Silver.		Copper.		Lead.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine oz.		*Fine oz.*		*Pounds.*		*Pounds.*		
1904	1,882.60	$38,917	42,231	$24,167	....	....	295,749	$12,743	$75,827
1905	5,785.59	119,599	58,627	35,411	49,647	$7,745	656,606	30,861	193,616

Beaver Creek district.—At the East Pacific mine near Winston, the ore which carries values in gold, silver, and lead, is treated by concentration and plate amalgamation. The Custer mine in the same district is producing gold-silver ore. The shaft at the close of the year was being sunk to the sixth level.

Cedar Plains district.—The Black Friday mine in the Cedar Plains district produced considerable gold-silver ore during the year, but was later closed down. The Blacker mine in the same district was operated with good results. The Eclipse-Argo Mining Company treated its copper ore in a 50-ton concentrator on the property.

Park district.—A cyanide plant was built during the year to treat the ores of the Park-New Era group near Hassel.

Backer district.—Placer mining is still in progress in the Backer district near Diamond City, where some deep mines are also productive.

CASCADE COUNTY.

Montana district.—The value of the metals won in Cascade County during 1905 was nearly double the value of the output during 1904. The mining in the county is almost wholly confined to the Montana district at Neihart, in which the increased activity was due to the development of the Hartley and Alice and other properties. The American Smelting and Refining Company bought the dump at the Florence mine and shipped a large tonnage from it during the year. The lead-silver ores of the district are sent to the East Helena smelter for treatment. The mines are operated chiefly through tunnels, but the Florence and the Hartley have winzes 400 and 200 feet deep, respectively.

Metallic production of Cascade County, Mont., in 1904 and 1905.

Year.	Gold.		Silver.		Lead.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine oz.		*Fine oz.*		*Pounds.*		
1904	6.25	$129	204,574	$117,059	718,308	$30,952	$148,140
1905	183.18	3,787	415,708	251,088	747,686	35,141	290,016

CHOUTEAU COUNTY.

Little Rockies district.—The Little Rockies district, about 50 miles south of the Great Northern Railway, has very recently brought Chouteau County into prominence as a gold producer. The ore is similar in its character and mode of occurrence to that of Fergus County—that is, it is a cyanide gold ore in the midst of sedimentary limestones penetrated by igneous rocks often in the form of laccoliths. One company was producing in 1904; two companies, the Alder Gulch and the Ruby Gulch, were producing during 1905, and it is expected that others will soon enter the producing class. The Ruby Gulch Mining Company has a cyanide plant of 120 tons capacity, built in 1904; the Alder Gulch Mining Company has a similar plant, said to have a capacity of 160 tons.

DEERLODGE COUNTY.

Georgetown district.—The Georgetown district near Cable is easily the most important mining region in Deerlodge County. The ore of the Gold Coin mine is treated without concentration in a 30-stamp mill by plate amalgamation. Considerable gold ore from the Southern Cross mine was sent to the Washoe smelter at Anaconda, where it was used for fluxing and for furnace lining. A cyanide plant is now in process of construction on this property. At the Cable mine underground development work was carried on during the year. Mr. W. R. Allen has a hydraulic elevator in operation on his placer ground along French Gulch in the Heber district.

FERGUS COUNTY.

The value of the metallic production of Fergus County for 1905 shows a decrease of about $10,000, but the general condition of the industry remains satisfactory and development work during the year has given good results.

Metallic production of Fergus County, Mont., in 1904 and 1905.

Year.	Gold.		Silver.		Lead.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ozs.		*Fine ozs.*		*Pounds.*		
1904	61,168.50	$1,264,463	1,519	$839	....	....	$1,265,302
1905	60,719.80	1,255,190	3,369	2,035	10,000	$470	1,257,695

North Moccasin district.—The most important district in the county is in the North Moccasin Mountains near Kendall. Here the Barnes King Mining Company has a 220-ton cyanide plant; before being cyanided the ore is crushed dry and sized to one-fourth inch. The property is developed by a shaft 250 feet deep and a 500-foot tunnel. Some ore has been obtained by working open cuts. The cyanide mill has a crushing capacity of 500 tons and a treatment capacity of 300 tons per day. The mine is opened by means of a vertical shaft 600 feet deep and an 800-foot tunnel.

Warm Spring district.—In the Warm Spring district, near Gilt Edge, the Gold Reef Mining Company has a 370-ton cyanide plant using the dry crushing system. The mine is opened by well-timbered tunnels aggregating 6,000 feet and a winze 200 feet deep. The Chicago Montana Mining Company operated for the first part of the year only. The Maginnis mine is in the same mining district, but is located near Maiden. It has a 10-stamp mill, a Huntington mill with plate amalgamation, and a cyanide mill to treat the pulp. It is opened by about 2,000 feet of tunnels and a winze 200 feet deep.

FLATHEAD COUNTY.

Libby district.—At present the Libby district is the only productive mining district in Flathead County. The Rustler Mining and Milling Company is operating the Snowshoe mine. It has a 250-ton concentrator and sends the concentrates to the smelter at Everett, Wash. The mine is opened by a vertical shaft 450 feet deep and about 6,000 feet of tunnels. Several placer mines in the same district were operated during the year by the ordinary hydraulic methods.

GRANITE COUNTY.

The decrease in the silver production of Granite County is due to the closing down of the Granite and Bimetallic mines and mill August 1, 1905. Since that time lessees have worked in the mines. The production of gold in the county is increasing rapidly, and development work is being prosecuted vigorously in some parts of the county. Placer mining is still in progress along Flint Creek, but the output is decreasing. On the other hand, gold quartz mining, especially near Garnet, shows a substantial increase in output.

Metallic production of Granite County, Mont., in 1904 and 1905.

Year.	Gold.		Silver.		Copper.		Lead.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ounces.		*Fine ounces.*		*Pounds.*		*Pounds.*		
1904	4,331.10	$89,532	1,293,296	$740,036					$829,568
1905	7,353.35	152,007	718,271	433,836	6,144	$959	38,687	$1,818	580,620

First Chance district.—Dr. Peter S. Mussigbrod has been developing and operating mines in this district, near Garnet, for several years. In 1905 he operated, chiefly through lessees, the Lead King, the Crescent, the Red Cloud, the Fourth of July, the Robert Emmett, the Free Coinage, and the San Jose. The mines are developed mainly by means of tunnels. Mr. S. I. Ritchie owns the Nancy Hanks, from which some high grade gold ore was shipped to East Helena.

Metallic production of the First Chance district, Granite County, Mont., in 1904 and 1905.

[Fine ounces.]

Year.	Gold.		Silver.		Total value.
	Quantity.	Value.	Quantity.	Value.	
1904	1,982.35	$40,979	2,700	$1,545	$42,524
1905	6,133.95	126,800	7,052	4,259	131,059

Flint Creek district.—The mines of the Granite Bimetallic Consolidated Mining Company are opened by vertical shafts to a depth of 1,700 feet. The company has a 100-ton stamp mill at Philipsburg, to which the ore is conveyed by means of an aerial tramway. Some old tailings were treated as well as crude ore. The Goodhope mine at Philipsburg is now owned by the same parties. It is opened by means of a 3,000-foot adit tunnel. This property is equipped with a 10-stamp wet crushing mill, using pan amalgamation. The Hobo mine is developed by a 3,000-foot tunnel. The Sweet Home mine, less than 2 miles from Philipsburg, has a 5-stamp, wet crushing, silver mill, with pan amalgamation.

Red Lion district.—The Milwaukee Gold Extraction Company is operating the Hannah mine in the Red Lion district. The company has a 100-ton Chilian mill, with a cyanide plant.

South Boulder district.—At the Gold Reef mine, in the South Boulder district, there is a 40-stamp mill using plate amalgamation. The mine is opened by about 2,000 feet of tunnels.

JEFFERSON COUNTY.

Jefferson County had a prosperous year in 1905 in the mining industry. The output of all the metals shows a good increase, the smallest increase being in the gold product. There are several mining districts in the county, the most important at present being the Cataract, the Lump Gulch, the Elkhorn, and the Colorado.

Metallic production of Jefferson County, Mont., in 1904 and 1905.

Year.	Gold.		Silver.		Copper.		Lead.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine oz.		*Fine oz.*		*Pounds.*		*Pounds.*		
1904.....	7,202.40	$148,887	331,091	$189,454	11,100	$1,423	401,515	$17,301	$357,065
1905.....	8,765.45	181,198	434,138	262,219	174,073	27,155	1,081,817	50,846	521,418

Cataract district.—The Bullion mine was worked by the Cataract Copper Mining Company, which installed a 150-ton concentrator at the mine; it was completed only in time to operate about two months of the year. The company also has a 200-ton smelter. The Basin Gold and Copper Mining Company operated the Hope and the Jib mines, sending the gold-silver ore to the East Helena smelter. The Gray Eagle mine was worked under a lease. The mine is opened by three tunnels, aggregating 3,400 feet in length. Shaft sinking was in progress at the close of the year at the Eva May mine; the shaft was sunk from the 650-foot level to the 850-foot level during the year. Other properties operated include the Custer, Hiawatha, Minneapolis, Hattie Ferguson, High Ore, Garfield, and Apollo mines.

Metallic production of the Cataract district, Jefferson County, Mont., in 1904 and 1905.

Year.	Gold.		Silver.		Copper.		Lead.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ounces.		*Fine ounces.*		*Pounds.*		*Pounds.*		
1904.......	977.00	$20,196	146,444	$83,797	....	....	150,000	$6,464	$110,457
1905.......	1,408.47	29,116	131,965	79,707	132,073	$20,603	173,529	8,156	137,582

Colorado district.—In the Colorado district, near Wickes, the Helena and Livingston Smelting and Reduction Company worked the Alta, Comet, and Gregory mines, sending the ore from all three, carrying values in silver, lead, and gold, to the East Helena smelter. The Minnesota mine was worked during part of the year. Coyle & Turner shipped tailings from the chlorination plant of the Minah mine to the smelter. Among other producing mines were the Reliance, Bell, Boston, and State.

Metallic production of the Colorado district, Jefferson County, Mont., in 1904 and 1905.

Year.	Gold.		Silver.		Copper.		Lead.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ounces.		*Fine ounces.*		*Pounds.*		*Pounds.*		
1904.......	341.00	$7,049	21,198	$12,130	11,100	$1,423	66,930	$2,884	$23,486
1905.......	777.11	16,064	66,368	40,086	23,380	3,647	409,672	19,255	79,052

Elkhorn district.—A large tonnage of gold ore was shipped from the Gould and Currie mines to the East Helena smelter, where it was used for fluxing purposes. Some shipments were made from the Union and Scioto mines. Other producers during the year include the Elkhorn Queen, Silver Hill, and Peacock. Mr. J. H. Longmaid is making preparations to reopen the Elkhorn mine.

Lump Gulch district.—The Liverpool Mining Company is operating the Liverpool and Washington properties in the Lump Gulch district, near Clancy, on a large scale. The mine is opened by a vertical shaft 750 feet deep. The ore occurs in a fissure vein, and carries values in lead and silver.

Warm Spring district.—The Carbonate Chief mine, near Clancy, is in operation. The mine has a vertical shaft 200 feet deep, and three tunnels, each 1,400 feet long. Part of the dump from the Bell mine was shipped to smelter.

LEWIS AND CLARK COUNTY.

The metallic production of Lewis and Clark County for 1905 is slightly less than for 1904 in both quantity and value, except as to lead. The output of placer gold is decreasing, as well as the product of the deep mines. This decrease is chiefly due to conditions in the districts near Marysville. Elsewhere in the county the production is increasing.

Metallic production of Lewis and Clark County, Mont., in 1904 and 1905.

Year.	Gold.		Silver.		Copper.		Lead.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ounces.		*Fine ounces.*		*Pounds.*		*Pounds.*		
1904.....	29,437.75	$608,531	177,489	$101,561	7,067	$906	35,688	$1,538	$712,536
1905.....	27,504.14	568,561	153,590	92,768	5,705	890	205,283	9,648	671,867

Helena district.—The Howard and Fargo mines in the Helena district were operated and the ore was shipped to the smelter. The Pittsburgh and Montana Copper Company developed the Spring Hill mine, about 4 miles south of Helena, for the purpose of supplying the Pittsmont smelter at Butte with sulphide ore. The Spring Hill ore is an iron sulphide carrying some values in gold.

Ottawa district.—The Bald Butte Mining Company has a 40-stamp mill, with 16 Frue vanners, the gold being amalgamated on plates. The concentrates, carrying values in copper and lead, are sent to the East Helena smelter. The mine is opened by 27,000 feet of tunnels, winzes, and raises, besides a vertical shaft of 400 feet extending from the 600-foot level to the 1,000-foot level. The Montana Mining Company (Limited) is working the Drum Lummon mine. It has a shaft 1,200 feet deep, and about 3,000 feet of tunnels. The company has a 40-stamp mill, with plates and vanners, and also a 400-ton cyanide plant. At present the company is working a large tonnage of old tailings in the cyanide plant. The Penobscot Mining Company worked the Belmont mine during part of the year, but late in the year the equipment from this mine was transferred to the Elkhorn mine in Jefferson County.

Stemple district.—The Gould Mines Company, operating the Jay Gould and other mines in the Stemple district, has a 30-stamp mill with a cyanide plant to treat the tailings. The mine is opened by a 1,000-foot adit tunnel and a winze 265 feet deep.

Unionville district.—The Whitlatch-Union mine has been reopened by the Whitlatch Mining Company. During the year the shaft was deepened to 500 feet, a 20-stamp mill was erected, and electric power was obtained to run the drills and the mill. The mill has plates for amalgamation and also Overström tables for concentration.

MADISON COUNTY.

The production of metals in Madison County in 1905 shows a marked increase in quantity and value over 1904. The output of placer gold decreased slightly, but the gold from deep mines increased more than an equal amount. The placer product of the county, amounting to 13,122.13 ounces of gold, valued at $271,258, is obtained almost wholly from Alder Gulch, and a large part of it is obtained by dredging.

The deep mines of the county are numerous and are found in all parts; the mining districts are, therefore, numerous.

Metallic production of Madison County, Mont., in 1904 and 1905.

Year.	Gold.		Silver.		Copper.		Lead.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ounces.		*Fine ounces.*		*Pounds.*		*Pounds.*		
1904......	31,385.20	$648,789	125,489	$71,806	11,300	$1,449	185,881	$8,010	$730,054
1905......	35,187.75	727,395	137,840	83,255	25,437	3,968	466,828	21,941	836,559

Lower Hot Springs district.—Activity in the Lower Hot Springs district near Norris was much increased, and small shipments were made from numerous properties. The Red Bluff mine was worked under leases. Some silver ore was shipped from the Hecla mine. The New York Belle mine was in operation, and the Black Hawk Mining Company recovered some gold and silver from the Black Hawk mine.

Metallic production of the Lower Hot Springs district, Madison County, Mont., in 1904 and 1905.

Year.	Gold.		Silver.		Copper.		Lead.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ounces.		*Fine ounces.*		*Pounds.*		*Pounds.*		
1904.........	75.00	$1,550	....	....	....	....	....	....	$1,550
1905.........	950.99	19,659	19,347	$11,686	1,600	$250	16,290	$766	32,361

Mineral Hill district.—The Garnet Gold Mining Company operated the Galena mine in the Mineral Hill district near Pony. The mine is opened by a tunnel 2,000 feet long and is provided with a 20-stamp mill, with plate amalgamation and concentration. The Mammoth Mining and Power Company worked the Mammoth mine by means of three tunnels having a total length of 1,500 feet. The ore is treated in a 50-ton roller concentrating mill, and yields copper, silver, and gold values. Some work was done in the Ned and the Mountain Cliff mines, but much more work was done in the Clipper and Boss Tweed group, where a pyritic ore carrying considerable gold is obtained. Some of the ore is smelted and some of it is treated in an amalgamating mill, and the concentrates are shipped to the smelter.

Metallic production of the Mineral Hill district, Madison County, Mont., in 1904 and 1905.

Year.	Gold.		Silver.		Copper.		Lead.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ounces.		*Fine ounces.*		*Pounds.*		*Pounds.*		
1904	3,426.50	$70,832	4,023	$2,302					$73,134
1905	4,321.78	89,339	4,356	2,631	3,205	$500	85,326	$1,010	96,480

Rabbit district.—The Rabbit district shows a marked decrease in production in 1905, the total value of the metallic product declining from $53,928 to $14,597. This was due chiefly to the closing of the Watseca mine early in the year. Since that time some tailings on the property have been treated by the cyanide process. Other properties worked during the year include the Abbie Alice, Anything, Legal Tender, Cooper, and Emma.

Sheridan or Mill Creek district.—In the Sheridan or Mill Creek district the Bismarck Nugget Gulch Consolidated Mining Company closed down in August. The company was reorganized in October. The Toledo mine of this company has a 750-foot incline shaft, and the company has a 150-ton concentrating mill.

Silver Star district.—The Green-Campbell Consolidated Mining Company shipped some smelting ore during the year, and had work in progress on a 100-ton concentrating mill with some novel features. The mill is to be run by electric power. The Hudson Mining Company shipped gold-silver ore from the Hudson mine. Work was prosecuted in the Broadway mine, which has an incline shaft of 550 feet, a 20-stamp mill, and a cyanide plant, which, however, were destroyed by fire. The Moonlight Mining Company shipped some gold-silver ore.

Metallic production of the Silver Star district, Madison County, Mont., in 1904 and 1905.

Year.	Gold.		Silver.		Copper.		Lead.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ounces.		*Fine ounces.*		*Pounds.*		*Pounds.*		
1904	2,083.15	$43,062	768	$439					$43,501
1905	3,189.58	65,934	4,435	2,679	6,000	$936	83,330	3,917	73,466

Summit district.—The Kearsarge mine was worked during the first part of the year; the closing of the mine about October 1 was said to be due to lawsuits. The Easton and Pacific group near Virginia City has a vertical shaft 300 feet deep and two adit tunnels of a total length of 3,500 feet. There is a 10-stamp mill on the property, with four Frue vanners; there is also a cyanide plant.

Upper Hot Springs district.—The production of the Upper Hot Springs district near Norris is increasing. Some gold ore from the Columbus mine was treated in a cyanide plant. The Montana Revenue Mining Company operated the Monitor and Revenue group, recovering gold and silver values by means of amalgamation and cyaniding. The Galena mine was also worked.

Washington district.—The Lehigh mine was worked through an incline shaft of 170 feet. Some gold-silver ore was shipped from the George McKee and the High Bluff mines.

Whitehall district.—The Montana Mine Enterprise Company worked the Gold Hill mine for a time; later it was worked by lessees. Other mines operated include the Colorado, the Blue Bird, and the Mary Ingaber.

Wisconsin district.—The Noble Mining and Milling Company operated the Noble mine through a 2,000-foot tunnel, and sent the gold-silver-copper ore to the Washoe smelter.

MISSOULA COUNTY.

The metallic production of Missoula County for 1905 exhibits a good increase over that of 1904. The placer gold, coming from various creeks along Missoula River, shows an increase; and deep mines in two different districts, idle in 1904, report a production in 1905.

Metallic production of Missoula County, Mont., in 1904 and 1905.

Year.	Gold.		Silver.		Copper.		Lead.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ounces.		*Fine ounces.*		*Pounds.*		*Pounds.*		
1904	1,864.50	$38,543	45	$25					$38,568
1905	2,208.76	45,659	5,023	3,035	45,086	$7,034	31,516	$1,481	57,209

Trout Creek district.—The King and Queen Mining Company operated the Iron King mine in the Trout Creek district near Superior. The mine is opened by a shaft 300 feet deep and a 1,200-foot tunnel. The Amador Copper and Gold Mining and Milling Company has done extensive development work at the Amador mine near Iron Mountain. The vertical shaft at this mine reaches a depth of 700 feet.

Wallace district.—Development work is done in the Cape Nome group in the Wallace district near Clinton. A vertical shaft is down 300 feet. The Hidden Treasure mine is worked by the owner and by lessees. The ore carries copper, gold, silver, and lead.

PARK COUNTY.

The production of gold and silver in Park County in 1905 was less than in 1904. The production of placer gold shows an increase, but the deep-mine production decreased considerably.

Metallic production of Park County, Mont., in 1904 and 1905.

[Fine ounces.]

Year.	Gold.		Silver.		Total value.
	Quantity.	Value.	Quantity.	Value.	
1904	3,073.00	$63,524	3,333	$1,907	$65,431
1905	2,448.90	50,623	840	507	51,130

Crevasse district.—The Anderson mine near Jardine was operated for a time. The Conrad Stanford Company worked the Crevasse mine through two tunnels, 500 and and 1,100 feet in length. The company has a 10-stamp plate amalgamation mill, with Wilfley tables.

Sheepeater district.—The Kimberly Montana Gold Mining Company operated the Legal Tender group near Jardine. The company has a wet crushing plate amalgamation mill, and also a cyanide plant.

POWELL COUNTY.

The metallic production of Powell County decreased in 1905 as compared with 1904, except in lead and silver. The production of placer gold increased from 848.60 ounces to 1,471.97 ounces, and the production from deep mines increased in the Ontario district near Elliston and the Zozell district near Deer Lodge. The placer gold is chiefly obtained along Gold Creek, where Kohrs and Bielenberg are working on a large scale. The Gold Creek Dredge Company put in a dredge in the same region, which worked part of the year. Some work was done also on Elk Creek.

Metallic production of Powell County, Mont., in 1904 and 1905.

Year.	Gold. Quantity.	Gold. Value.	Silver. Quantity.	Silver. Value.	Copper. Quantity.	Copper. Value.	Lead. Quantity.	Lead. Value.	Total value.
	Fine ounces.		*Fine ounces.*		*Pounds.*		*Pounds.*		
1904	4,222.10	$87,278	16,668	$9,537	1,000	$128	7,200	$310	$97,253
1905	3,236.59	66,907	21,012	12,692	532	83	245,428	11,535	91,217

Coloma district.—The Quantock Mining and Milling Company did some work on the Comet mine, in the Coloma district. The company has a 15-ton Huntington mill.

Ontario district.—Handley and Vye developed the Big Dick mine near Elliston. The shaft is 300 feet deep; the ore contains gold, silver, and lead. Other mines producing during the year include the Youngbauer, the Lee Mantle, the Lone Hand, and the Beatrice.

Zozell district.—The Emery Mining Company has a concentrator for the ores of the Emery mine in the Zozell district near Deer Lodge, which is opened by an incline shaft of 700 feet and a vertical shaft 475 feet deep. The ore contains lead, silver, and gold.

SILVERBOW COUNTY.

The metallic production of Silverbow County in 1905, makes a new record in the history of the county, and results in a new record for the State so far as commercial value is concerned, as well as for the production of copper and zinc. The total value of all the metals produced during the year amounted to $55,643,230, as against $44,187,679 in 1904.

The cause of this large production is to be found in the high average prices of the metals during the year, especially copper, and, to a less extent, silver. This resulted not only in the active exploitation of known ore bodies, but also in active exploration, and, in some cases, in the discovery of new ore bodies. It also resulted in vastly increasing the ore reserves in the Butte mines, since large bodies of ore that could not be worked when copper was at 12 cents yielded good returns with copper at 18 cents. A goodly portion of the ore mined during 1905 consisted of ore of this character.

Metallic production of Silverbow County, Mont., in 1904 and 1905.

Year.	Gold. Quantity.	Gold. Value.	Silver. Quantity.	Silver. Value.	Copper. Quantity.	Copper. Value.
	Fine ounces.		*Fine ounces.*		*Pounds.*	
1904	46,974.40	$971,046	10,530,582	$6,025,704	290,032,979	$37,190,929
1905	61,251.20	1,266,175	11,191,016	6,759,373	304,307,893	47,472,031

Year.	Lead. Quantity.	Lead. Value.	Zinc. Quantity.	Zinc. Value.	Total value.
	Pounds.		*Pounds.*		
1904					$44,187,679
1905	1,140,666	$53,611	1,560,000	$92,040	55,643,230

Summit Valley district.—Omitting a small amount of placer work, mining in Silverbow County is confined almost entirely to the Summit Valley district at Butte, so that the production of that district is almost exactly the same as the production of the county. The chief companies operating in the district include the Anaconda Copper Mining Company, the Boston and Montana Consolidated Copper and Silver Mining Company, the Butte and Boston Consolidated Mining Company, the Parrot Silver and Copper Company, the Trenton Mining and Development Company, and the Washoe Copper Company, which are controlled by the Amalgamated Copper Company; the Montana Ore Purchasing Company, the Corra-Rock Island Mining Company, the Hypocka Mining Company, the La France Copper Company, and the Belmont Mining Company, which are controlled by the United Copper Company; the Original Consolidated Mining Company, the North Butte Mining Company, and the Pittsburg and Montana Copper Company. Besides these there are several other companies that are active and important producers on a smaller scale. Near the close of the year several new companies were organized to develop mining properties in the district. One of these was the East Butte Mining Company, which controls nine fractional claims in the southeastern part of the district. The company was able to ship some ore from the shallow workings on its claims while awaiting the arrival of machinery for deeper development.

The North Butte Mining Company in 1905 developed and proved the importance of the vein found on the Jesse claim in 1904. The company increased its holdings by purchasing several adjoining claims and others in the eastern part of the district. It also retimbered the shaft on the Speculator from the 1,600-foot level to the surface. While this work was in progress the ore from the mine was hoisted through the High Ore shaft.

The Anaconda Copper Mining Company deepened the shaft on the Anaconda mine 200 feet to the 2,400-foot level. It sank the shaft of the Never Sweat mine 300 feet to the 2,500-foot level, and the shaft in the Saint Lawrence 200 feet to the 2,000-foot level. The Boston and Montana Company deepened the shaft in the Pennsylvania 200 feet to the 1,800-foot level, and that in the West Colusa 200 feet to the 1,600-foot level. The company is also constructing a new 4-compartment shaft in the Leonard. Work on this shaft was begun at several different levels at once. A large new hoisting engine was ordered for the Leonard. The Trenton Company sank the Gagnon shaft 100 feet to the 1,900-foot level. The Parrot Company deepened the Parrot shaft 100 feet to the 1,800-foot level.

The Original Company deepened the shafts in the Original and the Steward each 200 feet to the 1,800-foot level.

Crosscuts have been run to the vein at the deeper level in all of these mines except the Never Sweat, and the results have been very satisfactory in all cases.

The La France Copper Company secured a lease on the old Lexington mine and reopened it. Some ore was obtained in the upper workings above the 600-foot level, and preparations were made to unwater the lower workings, which extend to 1,700 feet in depth.

The Montana Zinc Company continued work at the Alice mill, and treated considerable ore from the Lexington and other properties by electrostatic separators, so as to produce a zinc concentrate and an iron-lead concentrate. These concentrates were then shipped to suitable smelters.

In order to explore the district farther east the Boston and Montana Company began a shaft on the Greenleaf, located on the slope of the Continental Divide. The shaft was sunk about 100 feet during the year. It is intended to sink it to considerable depth.

Among the interesting developments of the year were the arrangements made for the increased use of electrical power in and about the mines and smelters. To fill the contracts made for additional power, the Helena Power and Transmission Company began the construction of a new dam on the Missouri River 12 miles below Canyon Ferry, and the Madison River Power Company started work on a new dam some distance above the old one.

Developments at the smelters have been along varied lines. Late in the year the Pittsburg and Montana Company succeeded in smelting low-grade ore without concentration and made some shipments of pig copper. The same company sank a winze 100 feet below the 1,200-foot level, and thereby demonstrated the downward continuation of the ore body.

The Butte and Boston Company closed its smelter in April, 1905, and has since sent its ores to the Washoe smelter.

At the Washoe, smelter improvements and enlargements continue. Eight additional roasters have been erected and two additional reverberatories have been constructed of the mammoth size first successfully used here—each one is 112 feet long. Two blast furnaces have been thrown into one, thus making a furnace 51 feet long. Two of these have been constructed during the year. The arsenic plant built in 1904 is so successful that it is to be enlarged at once. Preparations are being made to install electric power instead of steam at the concentrator. The capacity of the smelter is now fully 8,000 tons daily. Since the closing of several old smelters, cleanings from them have been sent to the Washoe and large quantities of the metals have been recovered therefrom.

At the Butte Reduction Works a new stack has been erected to accommodate new roasters and converters. It is of reenforced concrete, 18 feet in inside diameter, and 352 feet in height. Dust chambers and flues for recovering the flue dust have been erected and additional concentrating tables installed. Preparations are being made to enlarge the reverberatory furnaces and install new roasters and converters.

In conclusion it may be stated that the record for 1905 fully meets the expectations expressed in the last annual report, and it is very probable that the production of 1906 will surpass considerably that of the year under review.

NEVADA.

By Charles G. Yale.

GENERAL FEATURES.

Nevada is at present attracting more attention from the mining and speculative public than any other mining State in the West. This interest is largely based on prospective values, but there is no doubt that some of the mines already productive are making such a showing as to give confidence both in themselves and in others still in course of development in the same camps. Moreover, while the present excitement has been brought about by the developments in the newer camps of southern Nevada, it is also true that many of the older camps known for thirty or forty years have again become the seats of great activity.

After the working out of the great and famous bonanzas of the Consolidated California and Virginia mine on the Comstock and the failure for many years to find new ore bodies of value in any of the mines in that extensive lode, the mining public turned its attention elsewhere. As a result Nevada became neglected. It became difficult to obtain capital for investment in any of the mining districts, no matter what prospective showing was made. The annual bullion production of the State continued to decrease until it became a small amount as compared with the output in the palmy days of the Comstock lode.

The revival of interest in the mining industry of the State may be said to date from the discovery of ore at Tonopah about five years ago. As developments progressed at Tonopah it became apparent that the camp bid fair to become as permanent as old Virginia City itself. It has taken strenuous development work and large investment to bring Tonopah to its present position, but during the progress of this work the swarms of prospectors and miners attracted there spread over the adjoining region and discovered several other camps, some of them already overshadowing Tonopah itself in point of productiveness.

As one after another of these new districts were discovered and rich bodies of ore were found the mining world began to realize the great importance of the region under development. Both miners and investing capitalists saw opportunities for enriching themselves. An abundance of money was forthcoming for any mining venture. Miners obtained grubstakes with ease, secured valuable leases, were enabled to sell their best ore for cash as soon as it was brought to the surface, or could sell their claims outright for good prices if they so desired. It was possible also to obtain the money at once for equipment and development of any claim making any sort of showing. Under these conditions, not always prevailing in new districts, it is small wonder that remarkable and rapid development has taken place throughout southern Nevada. Moreover, the claims themselves merited the work done upon them as has been shown by the financial results, the most potent factor in the success which has followed the opening of the districts referred to.

The building of new railroads across Nevada had already been projected when these mines were discovered, but the mining developments have caused much more rapid construction of these roads and also the building from main lines of others designed to furnish transportation for the more important camps. These have not all been completed, or the State would have shown a far better record of bullion production for the year 1905. Only the richest of the ore could bear transportation where long wagon hauls were necessary to reach the railroad lines, but it is a matter of astonishment that such large quantities of ore were shipped under the circumstances. The nearest smelting works—hundreds of miles away—became overcrowded with ore from the new mines, and thousands of tons of second-grade ores have been piled on the dumps waiting for cheaper transportation or local reduction works.

It seems odd now, in view of subsequent development, that the first of the new camps, Tonopah, was held back a year or more by the lack of faith in the mines on the part of the companies which had bought the more prominent claims. Instead of proceeding on their own account, they adopted the leasing system, thus avoiding further investment and letting the lessees themselves prove the value of the claims. This they did, however, in short order, not only making fortunes for themselves but making great mines out of mere prospects, to the benefit of the more timid companies.

It may be confessed that to the leasing system is largely due the magnificent developments which have been made in many of the mines of the new camps. Some few of the companies have, of course, done their own work, but the lessees have really performed most of it. Some of these leases have resulted in the output of millions of dollars. Most of them expire early in 1907, and the companies themselves will thereafter conduct their own operations.

The development work in some of the larger properties has resulted in the blocking out of ore estimated in the millions in value, and these mines are now proceeding with the construction of their own reduction works, thus avoiding the shipping of any but the richest of the ores.

The ore from some of the recently discovered mines in these newer camps is phenomenally rich, running into the thousands of dollars per ton, while the main bodies of ore from which this selected material comes are of a higher grade than that usually found in quantity in mining operations. This is one of the main reasons why the State is attracting such widespread attention, for the mines at once become profitable so soon as ore is struck, since such ore will bear shipment and thus render immediate returns available.

There is a wide area of the southern desert section of Nevada over which prospecting operations are now being conducted, and this mineral belt has been found to continue over into Inyo County within the California boundary.

PRODUCTION.

Leaving aside further consideration of the general features of Nevada mining for the present, it will be well to take up the record made by the mines of the State for 1905, though these figures by no means reflect the conditions prevailing at the time of writing this chapter.

The following table shows the production of metals in the State in 1904 and 1905:

Production of gold, silver, and associated metals in Nevada in 1904 and 1905.

	1904.		1905.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold......fine ounces..	244,801.18	$5,060,494	254,927.51	$5,269,819	+ 10,126.33	+ $209,325
Silver............do....	4,268,122.81	2,432,830	6,482,081	3,915,177	+2,213,958	+1,482,347
Copper.......pounds..	29,317	3,115	413,235	64,465	+ 383,918	+ 61,350
Lead..............do....	4,229,727	161,777	3,457,124	162,485	− 772,603	+ 708
Zinc..............do....	....	....	697,757	41,168	+ 697,757	+ 41,168
Total.............	....	7,658,216	....	9,453,114	....	+1,794,898

The output by counties is given in the following table:

Production of gold, silver, copper, lead, and zinc in Nevada in 1905, by counties.

County.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*		*Pounds.*	
Churchill and Douglas	113.73	$2,351	3,878	$2,342	....	....
Elko	6,735.34	139,232	22,793	13,767	....	....
Esmeralda	96,027.20	1,985,058	93,697	56,593	56,436	$8,804
Eureka	753.97	15,586	78,475	47,399	64	10
Humboldt	1,897.07	39,216	5,864	3,542	....	....
Lander	220.64	4,561	27,291	16,484	3,000	468
Lincoln	51,336.28	1,061,215	63,291	38,228	22,808	3,558
Lyon	1,927.11	39,837	37,969	22,933	294,320	45,914
Nye	64,945.70	1,342,547	5,451,535	3,292,727	....	....
Storey	29,671.41	613,424	577,747	348,959	24,326	3,795
Washoe	1,091.29	22,559	417	252	....	....
White Pine	204.77	4,233	119,124	71,951	12,281	1,916
Total	254,927.51	5,269,819	6,482,081	3,915,177	413,235	64,465

County.	Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
Churchill and Douglas	40,000	$1,880	....	....	$6,573
Elko	186,212	8,752	78	$5	161,756
Esmeralda	169,915	7,986	....	....	2,058,441
Eureka	525,304	24,689	12,020	709	88,393
Humboldt	....	....	....	....	42,758
Lander	....	....	....	....	21,513
Lincoln	302,127	14,200	685,659	40,454	1,157,655
Lyon	....	....	....	....	108,684
Nye	223,340	10,497	....	....	4,645,771
Storey	....	....	....	....	966,178
Washoe	....	....	....	....	22,811
White Pine	2,010,226	94,481	....	....	172,581
Total	3,457,124	162,485	697,757	41,168	9,453,114

By this it is seen that Nye is by far the county of the largest production, followed in order by Esmeralda and by Lincoln. As to mines the Tonopah Mining Company of Tonopah, Nye County, is the largest producer in the State, considering both gold and silver, and the next in order is the Tonopah Extension Mining Company of the same place. In gold alone, the Florence Goldfield Mining Company of Goldfield, Esmeralda County, is the largest producer, the Tonopah Mining Company of Tonopah coming second, and the Bamberger-Delamar Mining Company of Ferguson district, Lincoln County, third in rank.

The relative rank of the counties in point of production of the various metals is shown as follows:

Total product.	Gold.	Silver.	Copper.
1. Nye.	1. Esmeralda.	1. Nye.	1. Lyon.
2. Esmeralda.	2. Nye.	2. Storey.	2. Esmeralda.
3. Lincoln.	3. Lincoln.	3. White Pine.	3. Storey.
4. Storey.	4. Storey.	4. Esmeralda.	4. Lincoln.
5. White Pine.	5. Elko.	5. Eureka.	5. White Pine.
6. Elko.	6. Lyon.	6. Lincoln.	6. Lander.
7. Lyon.	7. Churchill.	7. Lyon.	
8. Eureka.	8. Washoe.	8. Lander.	
9. Humboldt.	9. Eureka.	9. Elko.	
10. Washoe.	10. Lander.	10. Humboldt.	
11. Lander.	11. White Pine.	11. Douglas and Churchill.	
12. Douglas and Churchill.	12. Douglas and Churchill.	12. Washoe.	

The following table shows, by counties, the comparative increase or decrease in output for the year 1905.

Increase (+) or decrease (−) in production of metals in Nevada in 1905 as compared with 1904, by counties.

County.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*		*Pounds.*	
Churchill and Douglas.	− 475.62	− $9,832	− 22,444	− $12,661	....	....
Elko	− 426.04	− 8,807	− 166,778	− 94,288	− 7,200	− $792
Esmeralda	−20,626.55	−426,391	− 36,722	− 17,745	+ 56,136	+ 8,765
Eureka	− 1,388.85	− 28,710	− 85,069	− 45,821	− 13,899	− 1,370
Humbolt	− 1,304.04	− 26,957	− 4,181	− 2,183	....	....
Lander	+ 49.29	+ 1,019	+ 7,282	+ 5,079	− 200	+ 20
Lincoln	− 1,517.38	− 31,368	− 62,954	− 33,737	+ 22,808	+ 3,558
Lyon	− 4,428.29	− 91,541	− 32,608	− 17,295	+294,320	+45,914
Nye	+43,335.40	+895,822	+3,269,824	+2,049,152	− 70	− 9
Ormsby	− 1.74	− 36	....	....	....	....
Storey	− 1,119.30	− 23,139	− 701,100	− 379,983	+ 24,326	+ 3,795
Washoe	− 851.88	17,610	− 105	− 45	....	....
White Pine	− 1,118.67	− 23,125	+ 48,813	+ 31,874	+ 7,697	+ 1,469
Total	+10,126.33	+209,325	+2,213,958	+1,482,347	+383,918	+61,350

Increase (+) or decrease (—) in production of metals in Nevada in 1905 as compared with 1904, by counties—Continued.

County.	Lead.		Zinc.	
	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*	
Churchill and Douglas	+ 40,000	+$1,880		
Elko	+ 48,943	+ 3,230	+ 78	$5
Esmeralda	−110,370	− 2,551		
Eureka	+ 12,272	+ 4,285	+ 12,020	− 709
Humboldt				
Lander	− 112,969	− 4,510		
Lincoln	− 49,401	+ 260	+685,659	+40,454
Lyon				
Nye	+ 89,140	+ 5,126		
Ormsby				
Storey				
Washoe				
White Pine	−690,218	− 7,012		
Total	−772,603	+ 708	+697,757	+41,168

Although there were only 122 deep mines producing in the State in 1905 compared with 142 in 1904, yet the output of ore was 432,202 tons, or 108,532 tons more than in 1904. The average value per ton was, however, lower; that is, in 1904 the average total value per ton was $23.57 and was $21.85 in 1905, and the average value per ton in gold and silver was $23.06 in 1904 and $21.23 in 1905. Even in the larger producing counties of Esmeralda, Lincoln, Nye, and Storey is there a marked falling off in the value of the ores shipped or treated, as is shown by the following table:

Tonnage of ore sold or treated, number of mines producing, and tenor of ores in Nevada in 1904 and 1905, by counties.

County.	Total tons of ore sold or treated.		Number of deep mines producing.		Average total value per ton.		Average value per ton in gold and silver.	
	1905.	Increase (+) or decrease (−) compared with 1904.	1904.	1905.	1904.	1905.	1904.	1905.
	Short tons.	*Short tons.*						
Churchill and Douglas	700	− 780	5	6	$14.58	$9.36	$14.58	$6.68
Elko	16,106	+ 194	9	6	16.07	9.66	15.67	9.11
Esmeralda	24,203	+ 5,491	24	30	133.40	85.05	132.84	81.36
Eureka	3,640	− 4,503	10	11	19.56	24.28	16.89	17.30
Humboldt	6,785	+ 695	5	4	9.91	6.30	9.91	6.30
Lander	425	643	7	7	18.64	50.62	14.00	49.52
Lincoln	175,686	+ 31,466	15	12	8.17	6.58	8.08	6.25
Lyon	17,392	− 12,694	10	5	5.64	6.24	5.61	3.60
Nye	91,651	+ 68,948	10	12	71.93	50.69	74.69	50.58
Storey	89,484	+ 19,512	15	13	19.51	10.80	19.51	10.75
Washoe	3,642	+ 1,348	11	4	17.64	6.21	17.64	6.21
White Pine	2,488	− 502	21	12	54.84	69.01	29.75	30.27
Total	432,202	+108,532	142	122	23.57	21.85	23.06	21.23

From the ore treated were obtained 1,023 tons of concentrates, yielding $265,063. The highest values in the concentrates were from Storey County, though the most tons were handled in Esmeralda County. As to old tailings, the total quantity treated was 112,302 tons, yielding $330,341. The largest amount in tons and in value came from Storey County, as the following table shows:

Tonnage and value of ore, concentrates, and old tailings in Nevada in 1905, by counties.

[Short tons.]

County.	Total ore.		Concentrates produced.		Old tailings treated.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Churchill and Douglas	700	$6,553				
Elko	16,106	155,515	31	$3,261	14,000	$46,100
Esmeralda	24,203	2,058,441	610	60,818	3,000	3,148
Eureka	3,640	88,393				
Humboldt	6,785	42,758	9	1,286		
Lander	425	21,513				
Lincoln	175,686	1,156,764			16,500	72,507
Lyon	17,392	108,584			13,628	39,234
Nye	91,651	4,645,771	158	19,886		
Storey	89,484	966,178	215	179,812	65,174	169,352
Washoe	3,642	22,610				
White Pine	2,488	171,701				
Total	432,202	9,444,781	1,023	265,063	112,302	330,341

The number of mines reporting production in the year under review was 132, while 828 mines sent in reports, but had no yield. Of the producing mines, 122 are "deep." Of these having gold as predominating value in the ore there are 65; in 27, silver predominates; in 23, lead; in copper, 4; in mixed ores, 2; and in zinc, 1. There are only 10 placers reporting product, 2 of which are hydraulic, and the others surface placers. The placers of the State were not operated to any extent in 1905, as the water supply was scant. They only yielded altogether some 400 ounces of gold and 98 ounces of silver. The largest number of productive mines is found in Esmeralda County, and the largest number of nonproductive is reported from Nye County. The following table shows the number of mines, classified by chief product, in 1905:

Number of mines, classified by chief product, in Nevada in 1905.

County.	Nonproducing mines.	Mines reporting product.	Gold placer mines.			Deep mines.						
			Hydraulic	Sluice.	Total.	Gold.	Silver.	Copper.	Lead.	Zinc.	Mixed ores.	Total.
Churchill and Douglas	27	7		1	1	2	2		2			6
Elko	26	9	2	1	3	2	2		1		1	6
Esmeralda	136	30				22	5	1	2			30
Eureka	15	11				1			9		1	11
Humboldt	58	4				2	2					4
Lander	35	7				1	5	1				7
Lincoln	160	14		2	2	10	1			1		12
Lyon	29	6		1	1	4		1				5
Nye	175	12				2	9		1			12
Ormsby	11											
Storey	30	13				13						13
Washoe	60	5		1	1	4						4
White Pine	66	14		2	2	2	1	1	8			12
Total	828	132	2	8	10	65	27	4	23	1	2	122

As to source of gold production, it will be seen that, with the exception of 400 ounces from placers, 51 ounces from copper ores, and 1,460 ounces from lead ores, the entire output was derived from siliceous ores, and the largest amount was from Esmeralda County. This is shown in the following table:

Source of gold product in Nevada in 1905 by kinds of ore, by counties.

[Fine ounces.]

County.	Placers.	Deep mines.				Grand total.
		Siliceous ores.	Copper ores.	Lead ores.	Total.	
Churchill and Douglas	0.97	101.59		11.17	112.76	113.73
Elko	299.92	6,424.20		11.22	6,435.42	6,735.34
Esmeralda		95,359.62		667.58	96,027.20	96,027.20
Eureka				753.97	753.97	753.97
Humboldt		1,897.07			1,897.07	1,897.07
Lander		181.94	38.70		220.64	220.64
Lincoln	42.96	51,293.32			51,293.32	51,336.28
Lyon	4.84	1,909.65	12.62		1,922.27	1,927.11
Nye		64,945.70			64,945.70	64,945.70
Storey		29,674.41			29,674.41	29,674.41
Washoe	9.67	1,081.62			1,081.62	1,091.29
White Pine	41.89	146.43		16.45	162.88	204.77
Total	400.25	253,015.55	51.32	1,460.39	254,527.26	254,927.51
Increase (+) or decrease (−)	−1,060.28	+12,262.08	+41.26	−1,116.73	+11,186.61	+10,126.33

Of the silver yield, out of a total of 6,482,081 ounces, 6,183,588 came from siliceous ores, 291,953 from lead ores, 4,753 from zinc ores, and 1,689 from copper ores. The placers yielded only 98 ounces. The total increase of silver over the previous year was 2,213,958 ounces, by far the largest proportion of the increase coming from the siliceous ores. The details of this output by counties is shown as follows:

Source of silver product in Nevada in 1905 by kinds of ore, by counties.

[Fine ounces.]

County.	Placers.	Deep mines.					Grand total.
		Siliceous ores.	Copper ores.	Lead ores.	Zinc ores.	Total.	
Churchill and Douglas		167		3,710		3,877	3,877
Elko	68	11,950		10,775		22,725	22,793
Esmeralda		20,750		72,947		93,697	93,697
Eureka				77,387	1,088	78,475	78,475
Humboldt		5,864				5,864	5,864
Lander		27,093	199			27,292	27,292
Lincoln	5	59,621			3,665	63,286	63,291
Lyon		36,478	1,490			37,968	37,968
Nye		5,443,487		8,048		5,451,535	5,451,535
Storey		577,747				577,747	577,747
Washoe	2	416				416	418
White Pine	23	15		119,086		119,101	119,124
Total	98	6,183,588	1,689	291,953	4,753	6,481,983	6,482,081
Increase (+) or decrease (−)	+98	+2,257,123	−831	−47,185	+4,753	+2,213,860	+2,213,958

REVIEW BY COUNTIES.

CHURCHILL AND DOUGLAS COUNTIES.

The production from these two counties was very small in 1905, being only $2,351 gold, $2,342 silver, and $1,880 lead, a total of $6,573. This is a falling off of $9,832 gold and $12,661 silver, but an increase of $1,880 in value of lead. There are only 7 mines in all reporting production—2 gold, 2 silver, 2 lead, and 1 placer. Practically none of the placers in Douglas County were operated, and there were no large producing deep mines in 1905, although some development work was carried on during the year. The production for 1905 came from the Hot Spring and Westgate districts, in Churchill County, and the Gardnerville or Silver Lake district, in Douglas County. A number of new camps were established late in 1905 and in 1906. Among the prominent ones are Fairview, Wonder, Eastgate, and Chloride, in the southern part of Churchill County. Fairview is close to the Nye County border, and Wonder and Chloride are about 18 miles northeast of Fairview. The ore of the mines at Fairview runs in the proportion of about 7 ounces of gold to 100 ounces silver, and a number of properties there are expected to ship ore in 1906. Some of the most prominent of the mines are the Fairview, the Eagle Mining Company, the Cyclone, the Nevada Hills Mining Company, and the Dromedary Hump, at Fairview; and the Wonder Mining Company and the Jack Pot Mining Company, at Wonder.

ELKO COUNTY.

In this county the production was $139,232 gold, $13,767 silver, $8,752 lead, and $5 zinc, a total of $161,756, which is a loss from 1904 of $100,652, principally in the silver output. There are 9 mines reporting output—2 hydraulic, 1 surface placer, 2 gold, 2 silver, 1 lead, and 1 yielding mixed ores. Some 26 mines report no production. In the deep mines there was very little difference in the quantity of ore worked, though only two-thirds the number of properties produced that were productive in 1904. The average total value per ton fell from $16.07 in 1904 to $9.66 in 1905; and the average value per ton in gold and silver fell from $15.67 to $9.11. This alone accounts for the reduction in output for the year. The placer gold yield was very small in 1905, but the prospects for an increased output are good, as some of the properties at Mountain City and Elko are being equipped with hydraulic plants. The largest producing deep mine in the county is the Lucky Girl claim of the Montana Mining Company, at Edgemont, which has a 20-stamp mill. Other producing mines are the Aura King, in Blue Jacket district; the Greenback and the Nelson mines, in Cope district; and the Black Forest Mining and Smelting Company, in Spruce Mountain district. The last-named company produced nearly all the lead credited to the county and most of the silver. It operates a 30-ton smelter, using a mixture of coke and pine wood for fuel. The camp at Tuscarora, formerly a large producer, was virtually idle in 1905, lessees only working. Seven or eight properties have since been merged into the Elko-Tuscarora Consolidated Gold Mining Company, and extensive developments are being carried on.

ESMERALDA COUNTY.

The output for the year from this county of $1,985,058 gold, $56,593 silver, $8,804 copper, and $7,986 lead yields a total of $2,058,441, making it the second county of the State in point of importance of yield, only Nye exceeding it. In fact, in gold output it is the leading county of Nevada, exceeding Nye County by $642,511. Yet even this was a falling off of $426,391 gold from 1904. There is also a falling off of $17,745 shown in silver, and of $2,551 in lead; at the same time there was an increase of ore worked amounting to 5,491 tons, and 6 more deep mines were producers than in 1904. The loss is manifest in the material reduction of average total value per ton from $133.40 to $85.05, and also in the gold and silver average value per ton from

$132.84 to $84.36. This shows that lower grades of ore were shipped than previously from certain dumps. The ore worked in the year amounted to 24,203 tons, valued at $2,058,441, of which 610 tons were concentrates worth $60,818, and 3,000 tons of old tailings valued at $3,148. There were 30 deep mines worked, of which 22 produced gold, 5 silver, 1 copper, and 2 lead. The gold was mainly derived from siliceous ores, although the largest proportion of the silver came from lead ores. The total decline in yield of $437,922 as compared with 1904 was caused entirely by the falling off of gold from Goldfield, the remaining camps of the State showing an increase. The Goldfield mines yielded $1,882,951 gold, and $5,188 silver in 1905, a reduction of $459,028 gold and $6,186 silver as compared with 1904, as is shown by the following table:

Production of Goldfield district, Esmeralda County, Nev., 1905.

[Fine ounces.]

Year.	Gold.		Silver.		Total value.
	Quantity.	Value.	Quantity.	Value.	
1904	113,293.23	$2,341,979	19,954	$11,374	$2,353,353
1905	91,087.77	1,882,951	8,589	5,188	1,888,139
Increase (+) or decrease (−)	−22,205.46	−459,028	−11,365	−6,186	−465,214

This apparently surprising showing was caused by the cessation of active leasing by many of the producing properties of 1904, more attention to progressive development, and the desire to hold the lower-grade ore mined until either reduction plants were provided or the completion of the railway from Tonopah made shipping of ores more profitable to the mining companies. This policy, the revival of the leasing system and the completion of the railway had the effect of increasing enormously the output of the district for 1906, and the 1906 report will probably show an output three or four times as great as that of 1905.

The largest producer at Goldfield in 1905 was the Florence Goldfield Mining Company. Other prominent producers were the Combination Mining Company, the Jumbo Mining Company, the May Queen Mining Company, the Jumbo Extension Mining Company, the Kendall Mining Company, the Red Top Mining Company, the Diamondfield-Black Butte Consolidated, the Sandstorm Mining Company, the St. Ives Gold Mining Company, the Conqueror Mining Company, the Goldfield Mining Company of Nevada, the Goldfield Simmerone Mines Company, the Goldfield C. O. D. Mining Company, and the Diamondfield Triangle Mining Company.

The Mohawk Mining Company will be the largest producer in 1906 and in fact the largest producer in Nevada. Of the numerous lessees several are shipping extremely rich ore, some of it running into thousands of dollars per ton. Other 1906 shippers will be the Blue Bull Mining Company, the Butte Goldfield Mining and Reduction Company, the Jack Pot Mining Company, the Goldfield Daisy Mining Syndicate, the Silver Pick Mining and Milling Company, the Laguna Mining Company, the Velvet Gold Mining Company, the Atlanta Mines Company, and the Goldfield Great Bend Mining Company.

There has been a revival of interest in the Esmeralda district near Aurora, and although the Golden Fleece was the only producer in 1905 there will be others in 1906. There were several small producers in the Columbus district (Candelaria), the principal one being the Georgine.

The Lida Queen Mining Company in the Gold mountain district was a small producer, and numerous other properties are being developed in this district and also in the old Montezuma district, some of which will be shippers in 1906. The mines in the Hawthorne district did not report any product in 1905, although a number were actively worked. The Southern Klondike mine in the district of the same name was a small producer in 1905, and the Nevada Alpine Mining Company in the Lone Mountain district shipped ore that ran high in silver and lead. In fact, most of the lead and silver credited to the county was produced by the Nevada Alpine.

The Nevada Rockland Mining and Milling Company in the Wilson district was a small producer.

In the Silver Peak district the only producer in 1905 was the Mohawk-Alpine Mining Company, but many properties have changed ownership or have been absorbed by companies, and much development is in progress. Among the operating mines are the Pittsburg Silver Peak Gold Mining Company, the Silver Peak and Drinkwater Gold Mining Company, the Nevada Smelter and Mines Company, and the Silver Peak Volcade Mining Company.

There were a number of producers in the vicinity of Sodaville and also at Mina, Goldyke, and in the Silver Star district. The free-milling ore was treated at the Stewart mill at Sodaville. Among the more important properties were the Moho, which produced gold, silver, and lead, and the Blue Light, which was the largest copper producer in the county.

A large number of claims are being operated at Palmetto, west of Lida, and some of these will ship ore in 1906.

The Buena Vista district, adjoining the California line and in the vicinity of the old Indian Queen mine, has several mines under development, but produced no metal in 1905.

EUREKA COUNTY.

The county of Eureka yielded a total of $88,393, of which $15,586 was gold, $47,399 silver, $10 copper, $24,689 lead, and $709 zinc. This shows a decrease from 1904 of $28,710 gold, $45,821 silver, and $1,370 copper, and an increase of $4,285 lead and $709 zinc. There was not half as much ore worked from this county as in 1904, although there was one more deep producing mine; but the average total value per ton increased from $19.56 to $24.28, and the average value in gold and silver increased from $16.89 to $17.30. Of the 11 deep mines reporting product from the county, 1 produced gold, 9 lead, and 1 mixed ores. The gold, silver, lead, and zinc came from lead ores.

The principal producing mines in the Eureka district were the Bullwhacker Mining Company, the Cyanide, the Diamond Mining Company, the Excelsior Mining Company, the Standard, and the Laurel. The Eureka district mines were not as active as in 1904, and the production decreased, as is shown in the following table:

Production of Eureka district, Eureka County, Nev., in 1905.

Year.	Gold.		Silver.		Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ounces.		*Fine oz.*		*Pounds.*		*Pounds.*		
1904	1,653.21	$34,175	45,558	$25,968	496,306	$19,897			$80,040
1905	651.85	13,457	36,341	21,950	416,308	19,566	9,120	$538	55,511
Increase (+) or decrease (−)	−1,001.36	−20,718	−9,217	−4,018	−79,998	−331	+9,120	+538	−24,529

The Eureka Consolidated Mining Company, the Richmond Consolidated Mining Company, both idle in 1905, have been acquired by the United States Smelting, Refining, and Mining Company, and are now being worked. In the Mineral Hill district the 1900 mine and the Mineral Hill Mining Company produced a small quantity of gold, silver, and lead—principally silver and lead.

In the Cortez district the Tenabo Mining and Milling Company and the Rhoda were producers; and the Gold Quartz Mining Company, in the Bullion district, at Beowawee, near Cortez, produced a small amount of gold in 1905. Other mines in the same district, among which are the Bullion Hill, the Grey Eagle, the Independence, the Wenban, and the Rough and Ready, are under development.

HUMBOLDT COUNTY.

Humboldt County yielded $26,957 less gold and $2,183 less silver than in 1904, the production in 1905 being $39,216 gold and $3,542 silver, a total of $42,758. There was one less producing deep mine, but 695 more tons of ore were worked. The year shows a falling off of an average value per ton from $9.94 to $6.30, or about one-third. Less than 10 tons of concentrates came from the ore worked. Of the 4 productive mines in the county, 2 yield gold and 2 silver. Both gold and silver came from siliceous ores.

The largest producer is the Pine Forest Gold Company, in the old Vicksburg district, in the extreme northern part of the county. Other producers were the Bonanza King Mining Company, in the Fitting district; the Fourth of July, in the Kennedy district, and the Sheba Gold and Silver Mining Company, in the Star district.

The placer mines at Golconda and Lovelocks were nonproductive in 1905. The Gold Run Development Company is, however, doing development work, and the Monte Cristo Mining Company and the Federal Mining Company, at Lovelocks, are engaged in extensive development work. The Nevada Superior Mines Company, operating near Humboldt House, commenced shipping ore in June, 1906.

LANDER COUNTY.

Only 7 mines reported production in this county in 1905, and 35 were nonproducers. Of the productive mines, 1 is gold, 1 copper, and 5 silver. The silver output, therefore, predominates and amounted to $16,484 in 1905. The gold was $4,561 and the copper nominal, the total being $21,513, as compared with $19,905 in 1904. Lander is thus one of the 3 counties of the State of Nevada which show an increase of output over 1904. There were in fact 643 tons less ore worked than in 1904, but the total average value per ton advanced from $18.64 in 1904 to $50.62 in 1905, and the average per ton in gold and silver from $14 to $49.52. The yield came chiefly from 425 tons of ore, all siliceous. The principal producing mines are the Austin Goldfield Mining Company, the Austin Hannapah Mining Company, and the Double H. mine, in the Reese River district; and the Little Giant, the Old Humboldt, and the Morning Star, in Battle Mountain district. None of the mines in the Galena district are very active, but the Reese River and Butte Mountain districts will probably show an increased production in 1906.

LINCOLN COUNTY.

This county ranks third in output in Nevada, and is one of the three which yielded over a million dollars in 1905, though the total was somewhat less than in 1904, as is shown as follows:

Production of gold, silver, lead, copper, and zinc in Lincoln County, Nev., 1904–5.

Year.	Gold.	Silver.	Lead.	Copper.	Zinc.	Total.
1904	$1,092,583	$71,965	$13,940			$1,178,488
1905	1,061,215	38,228	14,200	$3,558	$10,454	1,157,655

It will be noted that both copper and zinc are among the products for the year, which were not apparent in 1904. Only 14 mines report production, of which 12 are deep and 2 surface placers. Less of gold and silver were produced than in 1904, but more of copper, lead, and zinc. Although there were 3 less producing deep mines than in 1904, the tonnage value per ton fell off from $8.17 to $6.58, and the average value per ton in gold and silver from $8.08 to $6.25. Some $72,507 were recovered from working over 16,500 tons of old tailings. The returns indicate that all the gold, except a few ounces from placers, was derived from siliceous ores. The silver was derived from both siliceous and zinc ores.

The advent of new railroads is rapidly bringing life to old mining districts in the county and developing new ones as well. Among the more prominent new districts are those of Crescent, in the extreme southern portion of the county; El Dorado Canyon, near Searchlight; and Gold Butte, in the southeastern portion of the State. None of these reported any production for 1905. The older districts of Goodspring, Caliente, Bunkerville, Geyser, Logan, and Moapa were not productive in 1905, although several mines at Goodspring will probably be shippers in 1906.

The Bamberger-Delamar gold mines in Ferguson district were, as in 1904, the largest producer in the county and the third largest in the State. This company handles a large tonnage yearly in a 400-ton amalgamating and cyanide plant. The Searchlight district is the most active one in the county, and the producers in 1905 were the Quartette Mining Company, the Southern Nevada Mining and Milling Company, the Searchlight Mining and Milling Company, the Cyrus Noble Mining Company, and the Searchlight Parallel Mining Company. Other large operators reporting only development work were the Chiquita Consolidated, the Blackhawk Consolidated Mining Company, the New Era Mining Company, the Brockman Mines Company, and the Techaticup Mining Company. The production of this district in 1905 as compared with 1904 is as follows:

Production of Searchlight district, Lincoln County, Nev., in 1905.

Year.	Gold.		Silver.		Copper.		Lead.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ounces.		*Fine ounces.*		*Pounds.*		*Pounds.*		
1904	18,401.16	$380,386	13,477	$7,682					$388,068
1905	19,329.43	399,575	28,528	17,231	22,808	$3,558	12,064	$567	420,931
Increase	928.27	19.189	15,051	9,549	22,808	3,558	12,064	567	32,863

The Eagle Valley district, near Fay, had two producers—the Iris mine, owned by Woody & Dameron, and the Newport Nevada Mining Company.

Pioche district only reported one producer in 1905—the E. & F. Mining Company. Development work is now active, the Nevada-Utah Mines Company, the Janette Mining and Milling Company, the Raymond Ely West Mining Company, the Bristol Consolidated Copper Company, and the Gordon Mining Company being some of the properties now under development.

In the Yellowpine district the Nevada Keystone Mining Company and the Potosi Zinc Lead Mining Company were the only producers. The last-named company ships a zinc-lead ore carrying a small quantity of silver, and was the largest producer of zinc in the State.

LYON COUNTY.

The total output of Lyon County for 1905 was $108,684, of which $39,837 was gold, $22,933 silver, and $45,914 copper, a decrease from 1904 of $62,922. Both gold and silver show a material decrease, though the copper values were $45,914 more than in 1904. There are 4 productive deep gold mines, 1 copper mine, and 1 surface placer. Only one-half the deep mines produced in 1905, as compared with 1904, and the decrease in tonnage amounted to 12,694 tons. The average total value per ton increased 60 cents, but the average value per ton in gold and silver was $3.60, as compared with $5.64 in 1904. The old tailings worked yielded $39,234 from 13,628 tons. Both placers and copper mines yielded nominal amounts of gold, the greater part of both the gold and the silver being derived from siliceous ores.

The principal activity is in the Mason copper district, near Yerington. The Douglas mine was the largest copper producer in the county. The Crabb mine, also in the Mason district, and operating a small 2-stamp mill, was also a producer. The Federal Gold and Copper Company, in the Palmyra district, having an 8-stamp mill, was the largest gold-producing mine, and the Silver City mine, at Silver City, was a small producer. The larger portion of the gold and silver credited to the county in 1905 was obtained by the Nevada Reduction Works, at Dayton, which operated a 20-stamp mill and sixteen 100-ton tanks in the chlorination plant. At present the activity is in copper mines at Yerington. The shippers and prospective shippers are the Nevada Copper Company, the Douglas Nevada Copper Company, the Yerington Copper Company, and the Ludwig Copper Mining Company.

NYE COUNTY.

Nye is the most productive county in Nevada, its output being more than twice that of Esmeralda, the second in rank, and amounting altogether to $4,645,771. Of this, $1,342,547 was gold, $3,292,727 silver, and $10,497 lead. This is an increase for the year over 1904 of $895,822 gold, $2,049,152 silver, and $5,126 lead. These increases are entirely due to the operations of the mines in Tonopah district, which produced altogether, during the year, $4,449,486, as is shown in the following table:

Production of Tonopah district, Nye County, Nev., in 1905.

[Fine ounces.]

Year.	Gold.		Silver.		Total value.
	Quantity.	Value.	Quantity.	Value.	
1904	18,698.18	$386,526	2,119,942	$1,208,367	$1,594,893
1905	58,356.94	1,206,345	5,369,439	3,243,141	4,449,486
Increase	39,658.76	819,819	3,249,497	2,034,774	2,854,593

This result is all the more surprising when it is realized that there were in the entire county in 1905 only 12 producing mines. Of these the predominating metal in 2 was gold, in 9 was silver, and in 1 lead. It is to be noted also that by far the larger proportion of values in these Tonopah ores is silver. Of this metal there were 5,369,439 fine ounces produced, valued at $3,243,141. From this showing it is seen that the Tonopah ores average about three-fourths silver and one-fourth gold. Although only 2 more mines were producers in the county than in 1904, they treated 91,651 tons of ore, which is 68,948 tons more than in 1904. The average values per ton, however, were about one-third less; that is, the average total value per ton in 1904 was $74.93 and $50.69 in 1905; the average value per ton in gold and silver was $74.69 in 1904 and $50.58 in 1905. Only the very richest ores were shipped in 1904, but the advent of the railway permitted the shipping of lower grades. From the ores treated, 158 tons of concentrates were obtained, valued at $19,886. The gold came entirely from siliceous ores, as did virtually all of the silver, though some 8,000 ounces of the latter metal were derived from lead ores.

The marked increase in output of the county was due to increased shipments on the completion of the railroad, and would have even been greater had the railway been able to furnish more cars and the smelters able to take all the ore offered.

The largest producer in the county was the Tonopah Mining Company, which yielded over twice as much gold and silver as any other Nevada mine, and which shipped double the quantity of ore sent out by any other Nye County mine. Other Tonopah producers were the Tonopah Extension Mining Company, the Tonopah Belmont Mining Company, the Montana Tonopah Mining Company, the Tonopah Midway Mining Company, the North Star Tunnel and Development Company, the West End Extension Mining and Milling Company, and the Eureka-Alpine Mining Company. The Jim Butler Tonopah Mining Company and the MacNamara Mining Company will be among the shippers in 1906.

Development and exploration in districts tributary to Tonopah has been very active. Some of these districts are: Cloverdale, Kawich, Silver Bow, Round Mountain, Reveille, Lookout, Hannapah, Milletts, Clifford, Bellhellen, Golden Arrow, Jefferson Canyon, Ramsey, Cold Spring, and Lodi.

Of the numerous properties in these districts only the Southwestern Nevada Mines Company, in the Reveille district, shipped some silver-lead ore, and the Quincy Mining Company, in the Cold Spring silver district, shipped some silver ore. Aside from this, none of these districts report any production for 1905. The Old Glory Mining Company and the Sitka mine, in the Reveille district; the Cirac Mining Company, Cloverdale district; the Illinois mine, Lodi district; the Gold Reed Mining Company, at Kawich, and some others in Silver Bow district will be shippers in 1906.

In the Old Union district, at Berlin, the Nevada Company, which operates a 30-stamp mill was a large producer.

Development is very active in the Johnnie district in the southern part of the county, but no production was made in 1905. It is probable there will be some shippers in 1906.

In Bullfrog district, including Beatty, Rhyolite, Transvaal, Gold Center, the only producer in 1905 was the Montgomery Shoshone Consolidated Mining Company. Some of the larger operators are the Providence Mining Company, the Bullfrog Mayflower Mining Company (shipper 1906), the Crystal Springs Mining Company, the Bullfrog Mining Company of Nevada, the Bullfrog Gold Bar Mining Company, the Amethyst Mining Company, the Gibraltar Mines Syndicate, the Golden Sceptre Mining Company, the Montgomery Mining and Milling Company, the Bullfrog National Bank Mining Company, the Yankee Girl Mining Company, the Bonanza Mining and Milling Company, the Original Bullfrog Mining Company, the Tramp Consolidated Mining Company, and the Four Ace Mining Company.

In Manhattan district there was no production in 1905. The following are the principal mines, some of which will ship in 1906 or 1907: Seyler-Humphrey Mining Company, Little Grey Mining Company, Jumping Jack Manhattan Mining Company, Manhattan Gold Mining Company, Manhattan Consolidated Mines Company, Manhattan Consolidated Extension Mining Company, Manhattan Butler Mining Company, Manhattan Dexter Mining Company, Manhattan Giant Mining Company, Manhattan Nevada Mines Company, Manhattan Pinenut Mining Company, Manhattan Standard Mining Company, and Stray Dog Manhattan Mining Company. In the Round Mountain district there was no production in 1905. Among the mines which may produce in 1906 are: Round Mountain Virgin Mining Company, Mackey Mining Company, Round Mountain Mining Company, and Round Mountain Consolidated Mining Company.

STOREY COUNTY.

Formerly and for many years the largest proportion of the output of Nevada came from the Comstock mines in this county, but this is no longer the case. In fact, these mines yielded in 1905 nearly $400,000 less than in the previous year. The output for 1905 was $966,178, of which $613,424 was gold, $348,959 silver, and $3,795 copper. This output came almost entirely from the Comstock mines and from old tailings originating from these ores. Returns were received from 13 producing properties, all deep mines. There were 89,484 tons of ore and tailings, or 19,512 tons more than in 1904. The values fell off materially, however. The average value per ton in gold and silver fell from $19.51 to $10.75. Of the 89,484 tons of ore treated 65,174 tons were old tailings, yielding $169,352. Some 215 tons of concentrates are also included, which yielded $179,812. The gold and silver product all came from siliceous ores. Of the producing mines the leading one is the Ophir Mining Company; the others are the Silver City Mining Company, the Kinkead Mining and Milling Company, the Potosi Mining Company, the Chollar Mining Company, the Andes Silver Mining Company, and the Cosmopolitan, the Lady Ryan, and the Overland mining companies. In addition to these mines the three cyanide plants of the Comstock Mining and Milling Company and of the Chas. Butters Company (Limited) treated many thousand tons of old tailings by cyanide process, and besides the gold and silver recovered obtained about 12 tons of copper.

WASHOE COUNTY.

The production for this county in 1905 was $22,811 as compared with $40,466 in 1904. It was nearly all gold, only $252 being silver. There were only 5 producing mines—4 deep mines and 1 a surface placer. The 4 deep mines yielded 3,642 tons of ore, which was 1,348 more than in 1904, but the average value per ton was $6.21 in 1905 as against $17.64 in 1904. The largest producer is the Springfield-Nevada Mining Company in the Whitehorse district. The Gold Center and the Renegade, in the same district, were small producers. The only other producer was the Reno-Mispah Mining Company, in Peavine district. In spite of the decline in output development is very active in the county. In the Whitehorse district many mines have changed ownership, and there have been many consolidations and more effective work has been done. The production will largely increase in the near future. Some large operators and probable producers are the Green Hill Mining Company, the Belcher Gold Mining Company, the Keystone-Nevada Mining Company, the Texas-Nevada Mining Company, the Whitehorse-Nevada Mining Company, and the Pyramid Mining Company. There were no producers in the Galena district in 1905, but the Rocky Hill Mining Company, the Nevada Commonwealth Mining Company, and the Galena Hill Gold and Silver Mining Company are probable producers for 1906.

WHITE PINE COUNTY.

The production of this county in 1905 was $4,233 gold, $71,951 silver, $1,916 copper, and $94,481 lead, a total of $172,581, as compared with $169,375 in 1904. There were 14 mines reporting production, of which 2 are surface placers and the others deep mines. Eight of the latter have lead as the predominating metal in their ores. Of the 2,488 tons of ore worked, the average total value per ton was $69.01, as compared with $54.84 in 1904, and the average value per ton in gold and silver was $30.27, as against $20.75 in 1904. The lead and gold output show a reduction, but there is an increase in both silver and copper. The largest proportion of the gold was derived from siliceous ores, but most of the silver was from the lead ores.

In the Silver Canyon district, the Siegel Consolidated mine was the only producer in 1905. In the Gold Canyon (or Cherry Creek) district, the Hartford-Nevada Mining Company and the Wide West Mining Company were small producers. In the Duck Creek district the Success mine was a small producer. White Pine district, which is practically all silver-lead, and which produced $17,935 silver, $91,343 lead, and $270 gold, is the largest lead-producing district in the State, having yielded 1,943,504 pounds out of 3,457,124 pounds credited to Nevada in 1905. The principal producers are the Rocco Homestake, the Nevada Mining Company, the Lead King Mining and Milling Company, the Whitepine Mining Company, the Ne Plus Ultra, the Julia, and the Young Treasure mines.

The Newark Mining and Smelting Company, in the Newark district, was a small shipper of silver-copper-lead ore; while the Vulcan Mining and Smelting Company produced some silver and lead, and also nearly all of the copper product of White Pine County for 1905.

The new railway has given great impetus to the old copper district near Ely, Nev., and numerous consolidations of claims have taken place, while smelters are contemplated. The principal active companies are the Nevada Consolidated Copper Company, the Giroux Consolidated Mining Company, and the Cumberland-Ely Mining Company.

The Black Horse district, near Osceola, is being explored. The two most prominent new companies are the Mabel Mining Company and the San Pedro Mining Company.

The Osceola (Centennial district) quartz mines report no production for 1905, and only one placer mine, the White Rock Gold Mining Company, was operated in 1905.

LATER DEVELOPMENTS IN NEVADA.

This review of the conditions existing in Nevada, accompanied by the statistics for 1905, refers only to that year, but it may not be out of place to write briefly of some features relating to a subsequent date as they have been largely influential in bringing about the present widespread interest in the mining affairs of the State. The most important development in any single mine has been that which has occurred in the Mohawk mine, at Goldfield, where the richness and quantity of the ores obtained by the lessees during 1906 have arrested the attention of the mining world. From published reports concerning the leases in this mine (not verified by the United States Geological Survey) it appears that from April 18 to November 20, 1906, the gross value of the ores shipped by the various lessees in this mine amounted to $4,075,919, and the net values to $3,135,426. They also had ore stored and in transit amounting in value to $950,000 additional. It was estimated also that over $4,000,000 would be recovered during the remainder of the life of the leases, which expire in January, 1907. On November 20, 1906, the Mohawk merger took place, by which the Goldfield Consolidated Mines Company acquired the Mohawk, the Red Top, the Jumbo, and the Laguna properties, and they will be hereafter worked as one. The company has been organized with 5,000,000 shares of capital stock, par value $10 per share. Before the consolidation these separate properties had produced a total gross sum of $6,054,610. The Mohawk did not produce until 1906; the Jumbo began producing in July, 1904. The Red Top ore has been reduced in a small local mill operated under lease.

The average freight and treatment rate on ores shipped to smelters for 1906 has been $23.50 per ton. The cost of treatment of oxidized ores in the Combination Mines Company mill for the same period has been $5.82 per ton, with about 91 per cent extraction. This cost will be further reduced by a mill treating a large tonnage, and this mill has now been constructed. The mines are well developed considering the short time which has been occupied in the work. Under the leasing system, although the ore was exceptionally rich and the life of the lease short, there has doubtless been much robbing of the mine, which will not be the case when systematic development work is conducted by the company itself.

The wonderful output of these leases, occurring in such a brief period, has naturally attracted attention from all quarters. The stocks not only of the Goldfield properties but of mines in all the adjacent districts have been placed upon the market and have been purchased with avidity by the speculative public. There are now some 400 mining stocks of these Nevada districts being sold at the San Francisco Stock Exchange. Many of the mines represented by these stocks doubtless possess merit, while it is equally certain that numbers of them are valuable for speculative purposes alone.

NEW MEXICO.

By Waldemar Lindgren.

PRODUCTION.

The production of gold in New Mexico in 1905, as reported by the producers, amounted to $317,510, a decrease of $64,420 compared with the figures for 1904. On the other hand, the reported output of silver during the same year was 369,192 ounces, representing an increase of 154,639 ounces. The precious metals were obtained from 21 placers and 52 deep mines, the latter yielding 145,629 tons, an increase of more than one-third over the tonnage of last year. The average value per ton of the ore from the deep mines in gold and silver was $3.03, a decrease of 45 cents from 1904. The total value per ton was $16.21, a decrease of $1.98 from the figures of 1904. It should be noted that the larger part of the tonnage represents copper and zinc ores very poor in gold and silver. After eliminating these low-grade ores, the average tenor of the gold and silver ores proper would be about $9 per ton.

Production of gold, silver, and associated metals in New Mexico in 1904 and 1905.

Metal.	1904.		1905.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.........fine ounces..	18,476	$381,930	15,359.56	$317,510	− 3,116.44	−$64,420
Silver..................do....	214,553	124,103	369,192	222,992	+ 154,639	+ 98,889
Copper ....pounds..	4,972,170	646,382	6,126,025	955,660	+1,153,855	+309,278
Lead ....do....	3,122,872	134,283	1,510,209	70,980	−1,612,663	− 63,303
Zinc....................do....	13,493,835	674,692	15,142,254	893,393	+1,648,419	+218,701
Total..................	....	1,961,390	....	2,460,535	....	+499,145

Production of gold, silver, copper, lead, and zinc in New Mexico in 1905, by counties.

County.	Producing mines.	Tonnage.	Gold.		Silver.	
			Quantity.	Value.	Quantity.	Value.
		Short tons.	Fine ounces.		Fine ounces.	
Colfax, Otero, Rio Arriba, and Taos...	13	134	1,673.70	$34,598	276	$167
Dona Ana..............................	5	6,566	324.60	6,710	21,776	13,153
Grant	21	81,160	2,225.60	46,007	86,629	52,324
Lincoln	6	3,060	361.59	7,475	757	457
Luna....................................	5	1,346	....	....	5,199	3,140
Santa Fe, San Miguel, and Valencia...	8	400	302.00	6,243	42	25
Sierra	6	3,516	4,791.16	99,042	8,760	5,291
Socorro.................................	9	49,447	5,680.91	117,435	245,753	148,435
Total	73	145,629	15,359.56	317,510	369,192	222,992

Production of gold, silver, copper, lead, and zinc in New Mexico in 1905, etc.—Continued.

County.	Copper.		Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Pounds.*		
Colfax, Otero, Rio Arriba, and Taos	53,602	$8,362					$43,127
Dona Ana	96,058	14,985	327,707	$15,402	30,000	$1,770	52,020
Grant	5,291,222	825,431	321,035	15,089	257,203	15,175	954,026
Lincoln	14,404	2,247	7,511	353			10,532
Luna			463,956	21,806	225,000	13,275	38,221
Santa Fe, San Miguel, and Valencia	8,900	1,388					7,656
Sierra	46,664	7,280					111,613
Socorro	615,175	95,967	390,000	18,330	14,630,051	863,173	1,243,340
Total	6,126,025	955,660	1,510,209	70,980	15,142,254	893,393	2,460,535

Increase (+) or decrease (−) in production of metals in New Mexico in 1905 as compared with 1904, by counties.

County.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*		*Pounds.*	
Colfax, Otero, Rio Arriba, and Taos	−3,124.29	−$64,569	− 247	− $136	+ 35 356	+ $5,990
Dona Ana	+ 324.60	+ 6,710	− 2,325	− 788	+ 56,058	+ 9,785
Grant	−1,084.40	− 22,421	+ 11,836	+ 9,062	+ 862,714	+249,725
Lincoln	− 1,021.41	− 21,121	− 1,819	− 1,033	+ 14,404	+ 2,247
Luna	− 82.00	− 1,695	− 3,350	− 1,804	− 16,000	− 2,080
Santa Fe, San Miguel, and Valencia	+ 17.00	+ 366	− 408	− 235	− 18,308	− 2,149
Sandoval	− 92.00	− 1,899	− 1,035	− 599		
Sierra	+1,183.16	+ 24,446	− 8,295	− 4,574	+ 29,964	+ 5,109
Socorro	+ 762.91	+ 15,763	+160,282	+98,996	+ 189,667	+ 40,651
Total	−3,116.44	− 64,420	+154,639	+98,889	+1,153,855	+309,278

County.	Lead.		Zinc.	
	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*	
Dona Ana	−1,253,781	−$52,602	+ 30,000	+ $1,770
Grant	+ 141,893	+ 7,386	+ 257,203	+ 15,175
Lincoln	+ 5,250	+ 256		
Luna	− 207,816	− 7,080	+ 225,000	+ 13,275
Socorro	− 298,209	− 11,263	+1,136,216	+188,481
Total	−1,612,663	− 63,303	+1,648,419	+218,701

Tonnage of ore sold or treated, number of deep mines producing, and tenor of ores in New Mexico in 1904 and 1905, by counties.

County.	Total tons of ore sold or treated.		Number of mines producing.		Average total value per ton.		Average value per ton in gold and silver.	
	1905.	Increase. (+) Decrease. (−)	1904.	1905.	1904.	1905.	1904.	1905
	Short tons.	*Short tons.*						
Colfax, Rio Arriba, Otero, and Taos	134	− 526	22	4	$13.47	$66.52	$9.88	$4.11
Dona Ana	6,566	+ 986	5	5	15.62	7.92	2.50	3.03
Grant	81,160	+34,128	40	17	14.61	11.62	2.20	1.08
Lincoln	3,060	+ 2,240	16	3	12.29	2.70	12.17	1.85
Luna	1,346	− 230	10	5	23.73	28.40	4.21	2.33
Sandoval	....	− 46	9	....	32.28	....	32.28	....
Santa Fe, San Miguel, and Valencia	400	+ 135	15	7	20.90	9.08	7.55	5.61
Sierra	3,516	+ 2,221	12	3	49.15	18.09	47.47	16.02
Socorro	49,447	+ 4,382	21	8	29.15	25.14	3.34	5.38
Total	145,629	+43,290	150	52	18.19	16.21	3.48	3.03

Number of mines classified by chief product in New Mexico in 1905, by counties.

County.	Gold placer mines.			Deep mines.							Total mines producing.
	Hydraulic.	Surface placer.	Dry wash.	Gold.	Silver.	Copper.	Zinc.	Gold and silver.	Gold, silver, copper.	Silver, lead.	
Colfax	5	[a] 1	....	1	......	......	......	....	....	....	7
Dona Ana	....	....	....	......	......	[b] 2	......	1	....	2	5
Grant	....	3	....	......	[c] 5	5	1	1	[d] 3	2	20
Lincoln	....	3	....	1	......	1	......	....	[e] 1	....	6
Luna	....	....	....	......	......	......	1	....	....	4	5
Otero	....	1	1	......	......	1	......	....	1	....	4
Rio Arriba	1	....	....	......	......	......	......	....	....	....	1
San Miguel	....	....	....	......	......	2	......	....	....	....	2
Santa Fe	....	....	1	4	......	......	......	....	....	....	5
Sierra	2	....	1	......	1	[c] 1	......	....	1	....	6
Socorro	....	1	....	2	......	......	[f] 3	1	1	1	9
Taos	....	....	1	1	......	......	......	....	....	....	2
Valencia	....	....	....	......	......	1	......	....	....	....	1
Total	8	9	4	9	6	13	5	3	7	9	73

[a] Dredge.
[b] One copper-zinc mine.
[c] One silver-copper mine.
[d] One gold, silver, copper, zinc mine.
[e] Gold-silver, copper and lead.
[f] One copper, silver, lead zinc mine.

Source of gold production in New Mexico, by kinds of ore, in 1905, by counties.

[Fine ounces.]

County.	Placer.	Deep mines.			Total.
		Siliceous ore.	Copper ore.	Lead ore.	
Colfax, Otero, Rio Arriba, and Taos	1,649.68	22.02	2.00	....	1,673.70
Dona Ana	....	324.60	....	....	324.60
Grant	529.37	1,560.78	4.84	130.61	2,225.60
Lincoln	109.33	245.00	....	7.26	361.59
San Miguel, Santa Fe, and Valencia	193.60	108.40	....	....	302.00
Sierra	2,316.11	2,475.05	....	....	4,791.16
Socorro	7.25	5,636.07	37.59	....	5,680.91
Total	4,805.34	10,371.92	44.43	137.87	15,359.56

Source of silver production in New Mexico, by kinds of ore, in 1905, by counties.

[Fine ounces.]

County.	Placer.	Deep mines. Siliceous ore.	Deep mines. Copper ore.	Deep mines. Lead ore.	Total.
Colfax, Otero, Rio Arriba, and Taos	185	2	89	....	276
Dona Ana	....	347	....	21,429	21,776
Grant	202	59,053	6,339	21,035	86,629
Lincoln	5	131	....	[a] 621	757
Luna	....	....	....	5,199	5,199
San Miguel, Santa Fe, and Valencia	35	7	....	....	42
Sierra	235	4,514	4,011	....	8,760
Socorro	....	231,430	9,523	[b] 4,800	245,753
Total	662	295,484	19,962	53,084	369,192

[a] Copper-lead ore. [b] Two thousand ounces from copper-lead-zinc ore.

New Mexico contains producing gold and silver mines in 15 of the 25 counties, and the mineral-bearing belt extends diagonally across the State from Rio Arriba, Taos, and Colfax counties on the north, down to Dona Ana, Luna, and Grant in the Southwestern corner of the Territory. The metallic production, though not large, is extremely scattered, and was derived in 1905 from 73 mines.

The larger part of the metallic production is obtained from contact-metamorphic deposits or veins closely connected with the many intrusive bodies of granite-porphyry, monzonite-porphyry or granite, which are found in the Paleozoic limestones or sandstones of the Territory. A smaller part is derived from veins in surface flows of andesites or rhyolites like those of the Mogollon and Rosedale districts in Socorro County. Not much success has as yet attended the mining of the disseminated chalcocite and oxidized copper ores so universally occurring in the sandstones of upper Carboniferous or Mesozoic age.

As stated above, the gold production for 1905 showed a decrease compared with the figures of 1904. This is largely due to decreased yield of the placer operations in Colfax County, though the increase from Sierra County forms a partial compensation for this. The total placer yield in gold was $99,335, against $149,424 in 1904. It is possible that more active operations in the deep mines of the Pinos Altos and Mogollon districts may result in a slightly greater gold output in 1906.

The notable increase in the yield of silver is chiefly due to the mines of the Mogollon district, and a still larger production may be reported for 1906.

Lead ores appear to be more difficult to obtain than formerly; most of the lead-producing districts in the Territory show decreases in output of the metal. The smelters compete for these ores in a manner which should stimulate the production. At present the output of lead, 1,510,209 pounds, is fairly evenly divided between Dona Ana, Luna, Grant, and Socorro counties.

Copper, on the other hand, is produced in increasing quantities, chiefly from the Santa Rita, Fierro, and Burro Mountain mines in Grant County. Socorro County contributes a notable quantity from the Mogollon Mountains, and Dona Ana County comes third. The prospects are good for further progress in 1906. The copper ores of Grant County contain very small quantities of gold and silver.

The zinc production of New Mexico has in the last few years increased wonderfully, the whole industry practically centering in the Magdalena district of Socorro County. Smaller quantities of zinc ores are produced in Luna, Grant, and Dona Ana counties. The zinc ores contain no gold, and only a few ounces of silver per ton. This silver is not recovered, but the same mines produce silver-bearing lead and copper ores.

The combined value of the copper, lead, and zinc approaches $2,000,000, while the value of the gold and silver together scarcely amounts to one-fourth of this sum.

The smelters in operation were the El Paso plant of the American Smelting and Refining Company and the Deming plant of the Luna Lead Company. Both are lead smelters, and the latter was only in operation during part of the year. The Comanche Mining and Smelting Company has a 400-ton copper plant in operation at Silver City. The lead smelters of Los Cerillos and Socorro, the copper plants at Frazer Mountain, in Taos County, and at San Pedro, in Santa Fe County, remained closed.

PRODUCTION BY INDIVIDUAL COUNTIES.

BERNALILLO COUNTY.

A few prospects containing copper ores, with a little gold and silver, occur in Tijeras Canyon, in the foothills of the Sandia Range, and are reported to be contained in pre-Cambrian granites and schists. There is no production.

COLFAX COUNTY.

In 1905 Colfax County produced $31,138 in gold and 170 ounces of silver. This represents only about one-third of the production for 1904. The chief cause of this decrease is in the diminished output of the dredge of the Oro Dredging Company, located just below Elizabethtown. The gravel is said to have become poorer in grade, and in the latter part of the year operations were discontinued and the company went into bankruptcy.

The many creeks heading in the porphyry stock of Elizabethtown, intrusive into Carboniferous and Cretaceous strata are all gold bearing, and a fair quantity of placer gold was obtained during the year from the Moreno, Poñil and Ute Creek districts.

Some gold was also obtained from quartz mines, among which the old Aztec mine on the slopes of Baldy Mountain is the only one of importance. This mine, which many years ago produced much gold, is equipped with a 40-stamp mill.

DONA ANA COUNTY.

The principal mining region in Dona Ana County is the Organ district, where an extensive mineralization of copper and lead ores has taken place along the contacts of a large body of intrusive granite. The granite itself contains gold and silver veins.

At Organ the Torpedo mine of the Copper Bar Mining Company and the Memphis Copper Company reported some production, chiefly of oxidized ores in contact with metamorphosed limestone. The Torpedo mine is opened by shafts 158 and 278 feet in depth. The ore contains very little gold and silver.

The lead production is of more importance. The Stephenson-Bennett mine, working on a fissure vein in limestone near the contact, shipped ore during part of the year, and preparations were made to open the lower levels by a shaft 500 feet in depth. The ore carries a few ounces of silver per ton. The Modoc mine, 9 miles south of Organ, was also a producer part of the year, and an experimental dry concentrating plant, later dismantled, was installed. On the eastern side of the Organ Mountains, in the Black Mountain district, the Mormon vein, a fissure in granite, was worked for a time. This gold property is equipped with a Huntington mill. Development work was carried on in the Dona Dora, in the same district, and in the Texas mine, about 12 miles southeast of Organ, both gold properties.

GRANT COUNTY.

Grant County occupies third rank among the gold-producing counties of the Territory, being exceeded by Socorro and Sierra. The amount of gold produced in 1905 was $46,007. It is the second in importance among the silver-producing counties, the output being 86,629 ounces. Socorro yielded nearly three times this amount. The lead and zinc production does not amount to very much, the principal value of the total metallic production (excepting iron) of $954,026 being in copper. The county produced 5,291,222 pounds of copper, valued at $825,431.

The county contains a great number of mining districts, the more important of which are mentioned in the following pages. The mineral deposits are veins or contact metamorphic bodies, occurring in close connection with bodies of granitic porphyry intrusive in Paleozoic strata.

Silver City district.—There is not much activity near Silver City at present. Some silver ore is occasionally mined at Chloride Flat. The old smelting works of Silver City have been rebuilt by the Comanche Mining and Smelting Company, and a narrow-gauge railroad was in process of construction between Pinos Altos and Silver City.

Pinos Altos district.—At Pinos Altos, 9 miles north of Silver City, Paleozoic limestones near an intrusive mass of porphyry are cut by narrow fissure veins, replaced along the walls by copper and zinc sulphides. Veins in the porphyry carry copper and gold with smaller quantities of silver, lead, and zinc. Four producers contributed to the production of 1905, among which the Comanche Mining and Smelting Company was the most important.

Burro Mountain district.—The principal copper mines in this district, which have lately achieved prominence, are owned by the Burro Mountain Copper Company, at Leopold, and by the Comanche Mining and Smelting Company. The ore occurs as disseminated chalcocite in porphyry, which is concentrated to shipping grade. The first-mentioned company has a mill of 250 tons capacity. Very small quantities of gold and silver are present but are not recovered.

Central district.—The Central district, situated about 10 miles east of Silver City, contains many and varied deposits, some of which are of the contact metamorphic type. The principal valuable metal is copper. Among the operating companies are the Santa Rita Copper Company, the Hermosa Copper Company, the Copper Queen Mining Company, and the Empire Zinc Company. The famous old mines of Santa Rita are developed by tunnels and shafts, the maximum depth of the latter being 400 feet. The ore is treated in a 100-ton concentrating mill.

Other districts.—In the Kimball district, near Steins Pass, the Beck mine of the National Gold and Silver Mining Company reported production in 1905. In the Pyramid district, near Lordsburg, the Nellie Bly, the Silver Tree group, and the Viola group were worked, producing some silver and silver-copper ore. The Eureka and Apache districts, near Hachita, yielded some silver, copper, and lead. Some oxidized lead ore was also shipped from the Red Hill district, in the extreme southwestern corner of the Territory. In the San Simon district the Granite Gap and the Louise mines produced a high-grade oxidized lead ore with a moderate quantity of silver.

LINCOLN COUNTY.

Although reports have been received from all of the principal mines, Lincoln County has not a large production to its credit in 1905. Placer operations in the Jicarillo Mountains north of White Oaks were continued on a small scale.

White Oaks district.—At White Oaks development work was done on the Old Abe mine, owned by the Eagle Mining and Improvement Company. The shaft is being sunk to 1,500 feet and is reported to be dry even at that depth. The South and the North Homestake properties, which are developed by several shafts up to 1,000 feet in depth, were reported to be operated as one property.

Bonita district.—In Bonita mining district the Eagle Mining and Improvement Company was working the Hopeful group. Ore derived from an open cut is treated in a Huntington mill with amalgamation. At Alto, in the same vicinity, small shipments of gold and silver ores were reported by the Alto Mining and Milling Company. Many other properties are prospected in this district.

LUNA COUNTY.

Cooks Peak district.—In the Cooks Peak district, north of Deming, several smaller mines continued the production of silver-lead ore. The deposits occur in limestone close to the contact of an intrusive body of porphyry. As the ore must be hauled by wagon 14 miles, only high-grade lead ores are shipped; they contain from 5 to 10 ounces of silver per ton.

The principal producers were the Desdemona group, the Faywood Lead Mines, the Gold King group, and the Summit group.

The following table shows the production in the Cooks Peak district in 1904 and 1905:

Metallic production of Cooks Peak district, New Mexico, in 1904 and 1905.

Year.	Silver.		Lead.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Fine oz.		*Pounds.*		
1904	4,401	$2,545	576,795	$24,802	$27,347
1905	5,198	3,140	463,956	21,806	24,946

Florida district.—Only prospecting operations were recorded from the Florida Mountains southeast of Deming and from the old silver-lead camp of Victorio, at Gage, 20 miles west of the same town.

Tres Hermanas.—In the Tres Hermanas camp, 30 miles south of Deming, Lindauer and Thurman opened an important body of oxidized zinc ores, and a number of carloads were shipped during the fall months to the Empire Zinc Company at Gas, Kans.

OTERO COUNTY.

The mining activity in Otero County centers at Brice, in the Jarilla Mountains, 50 miles north-northeast of El Paso, the deposits occurring as fissure veins and contact metamorphic ore bodies in and around a mass of intrusive porphyry. The year witnessed considerable activity in the district, mainly in the way of development.

Dry placers are operated at Jarilla by the Electric Mining and Milling Company and by several other parties. The Southwest Smelting and Refining Company began work on the Nannie Baird, Lucky, and other properties, and intends building a local smelter. The Three Bears Mining Company continued its operations and shipped some copper ore carrying a little gold and silver.

At Tularosa, in the northern part of the county, copper ore was shipped by the Tularosa Mining and Milling Company. A 50-ton concentration plant was placed in commission in February, 1906.

RIO ARRIBA COUNTY.

The activity in Rio Arriba County, in the Bromide and Hopewell districts, was confined to prospecting. The Lower Flat placers prepared for operation, but the run was shortened by an accident.

The quartz veins are contained in pre-Cambrian granitic rocks and carry gold, silver, and copper. Development work was continued in the Tampa mine of the Tusas Peak Gold and Copper Mining Company, which has a vertical shaft 600 feet in depth. A mill is to be erected in 1906.

Among other developing properties are the Bromide, Red Jacket, Sixteen-to-One, Dillon Tunnel, Jawbone, Strawberry, Elliott and Kennedy, and Copper Knob group.

The copper deposits in Triassic sandstone north of Abiquiu were not worked, but it is reported that they will be reopened.

SANDOVAL COUNTY.

No production is reported from Sandoval County, which includes the old and formerly productive district of Cochiti, located about 50 miles north of Albuquerque in the Valles Mountains.

SAN MIGUEL COUNTY.

San Miguel reports a small production of copper, partly from a 50-ton leaching plant of the Blake Mining and Milling Company, near Tecolote, in the vicinity of Las Vegas.

The Pecos Copper Company continued development work in the Hamilton copper mine at Cowles, on the upper Pecos.

SANTA FE COUNTY.

As usual, placers were worked on a small scale by Mexicans in the New Placers mining district near Golden. The amount received has been estimated as closely as possible. The Gold Bullion Mining Company at Golden are preparing to install a dredge.

At San Pedro the extensive works and smelters of the Santa Fe Gold and Copper Mining Company remained closed down. Some gold, however, was produced near San Pedro from the San Lazarus, McKinley, and other veins in San Lazarus Gulch. Experiments were made by the Racine Concentrating Company on the lower Lazarus Gulch with a new type of dredge, designed to use only a small quantity of water.

Only assessment and development work was done in the Los Cerillos district, in which silver bearing lead-zinc veins cut across an intrusive body of monzonite-porphyry. Some experiments were made to ascertain whether some of the oxidized zinc ores from the upper levels could be profitably shipped.

SIERRA COUNTY.

Hillsboro (*Las Animas*) *district.*—More activity is noted at Hillsboro than for some time past. The Empire Gold Mining Company is an important producer from the Bonanza and Good Hope mines, and has a 10-stamp plate amalgamation mill. The ore contains gold, a little silver, and copper. The deposit is a fissure vein opened by three tunnels aggregating 2,200 feet in length. Important development work was done by the Sierra Consolidated Gold Mining Company on the Snake vein, and a mill is being erected. Development work is also carried on by the Black Peak Gold Mining Company. Small placer operations continued near Hillsboro.

Pittsburg district.—Important placer mining operations were carried on at the western part of the Caballo Mountains near Rio Grande. Two companies are operating: The Shandon Mining Company and the Union-Esperanza Mining Company, the latter having begun work in 1905. Both are pumping water for sluicing purposes from the underflow of Rio Grande.

Apache and Cuchillo Negro districts.—These districts are located near the northern boundary line of the county, near Chloride, Fairview, and Phillipsburg, and are 64 miles from the railroad. The deposits are fissure veins in andesite, and contain chiefly silver and copper, with some gold. The Black Range Copper and Gold Company reports some production of silver and copper, and is equipped with a 40-ton concentrating mill. The Black Knife, the Alta, and the Sierra mines report development.

The following districts contain silver ores in Carboniferous or Ordovician limestone:

Kingston (Black Range) district.—Little is now being done in this old silver-mining district, located 7 miles east of Hillsboro. The Moffett Mining and Milling Company has leased the Virginius mine and is erecting a 100-ton concentrating mill.

Lake Valley district.—The Lake Valley district, well known as a producer of large amounts of silver chloride, is idle.

Tierra Blanca district.—In the Tierra Blanca district, not far from Lake Valley, the Log Cabin mine is worked on a small scale.

Palomas district.—In the Palomas district, at Hermosa, 30 miles north-northwest of Hillsboro, the Palomas Chief is prospected. Silver ores occur here in limestone and talcose clay.

SOCORRO COUNTY.

Socorro is the largest county in New Mexico, and embraces a great number of mining districts, among which the Magdalena and the Mogollon (Cooney) are the most important. The former is a zinc-lead camp; gold, silver, and copper are produced in the latter.

The Oscura and San Andreas ranges are situated in the eastern part of the county. From the low grade copper deposits in sandstone at the eastern foot of the Oscura Range no production is reported.

In the San Andreas Range many copper and lead prospects exist, but their value is as yet problematical.

Magdalena district.—The Magdalena district, situated on the western slope of the mountain range of the same name, was formerly a lead-silver camp, but has now, since 1903, taken a place among the most productive of the zinc districts. The ores occur as replacement of carboniferous limestone in the vicinity of an intrusive mass of granite-porphyry. The oxidized ores consist mainly of the carbonates of zinc, lead, and copper, while the sulphide ores, which are found at a depth of from 200 to 300 feet, are composed of zincblende, galena, pyrite, and chalcopyrite. In 1904 the shipments consisted chiefly of oxidized ores, but in 1905 payable sulphide ores were found in large quantities, both in the Graphic and the Kelly mines, and will in 1906 make up the greater part of the output.

A small quantity of silver is present in the copper and lead ores. There is also a little silver in the zinc ores—about 3 ounces per ton, but this is not recovered.

The principal mines operating were the Graphic, owned by the Graphic Lead and Zinc Company, The Kelly, owned by the Tri-Bullion Mining Company and the Juanita, property of Mr. T. B. Catron. A total of 30,411 tons were shipped, of which 28,561 were zinc ores, 1,500 tons copper ores, and 350 tons lead ores. This compares with a total of 28,000 tons for 1904.

Metallic production of Magdalena district, Socorro County, N. Mex., in 1904 and 1905.

Year.	Gold.		Silver.		Copper.		Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine oz		*Fine oz.*		*Pounds.*		*Pounds.*		*Pounds.*		
1904...	7.44	$154	5,024	$2,906	3,200	$416	588,209	$29,593	13,493,835	$674,692	$707,761
1905...	....	....	4,800	2,899	320,000	49,920	390,000	18,330	14,630,051	863,173	934,322

In the corresponding table of the report for 1904 the assay values of zinc were given; in the table above one-quarter of this amount has been deducted in order to conform to the method adopted in this report for the recording of the zinc production.

A little lead-silver ore was shipped from the Water Canyon district, and some gold-bearing quartz was treated at the mill of the Wall Street mine in the Silver Mountain district, both in the Magdalena Mountains.

Rosedale district.—The production of the Rosedale district, situated 30 miles southwest of Magdalena, decreased last year on account of a temporary suspension of operations. The mine is working on a gold quartz vein in rhyolite, and is developed by a shaft with 3,500 feet of drifts on four levels. A 10-stamp amalgamating and cyanide mill reduces the ore.

Cooney district.—The northwestern part of Socorro County is occupied by barren lava flows, but in the southwestern corner is the important Cooney district. The district is situated in the Mogollon Mountains near the Arizona line and on the San Francisco River. In spite of its isolated position, 80 miles northwest of Silver City, which is the nearest railroad point, this district is making great progress and has a large production to its credit. Among the producing mines are the Last Chance, operated by the Ernestine Mining Company, and the Cooney mine, worked by the Mogollon Gold and Copper Company. Development work and mill construction is reported by the Enterprise Mining Company, the Helen Mining Company of the Confidence mine, and by the Little Fannie mine. The deposits are veins in Tertiary andesite; the prevailing values are in silver, gold, and copper, and much of the copper ores consist of bornite. The Ernestine mine is developed by 780 feet of shafts, and 5,000 feet of crosscuts and drifts. The reduction works consist of a 20-stamp mill of 50 tons capacity, with cyaniding and concentrating. The ores are crushed in cyanide solution. The Cooney mine has a vertical shaft 585 feet in depth with drifts and crosscuts aggregating 5,000 feet; also a concentrating plant of 100 tons capacity.

Metallic production of Cooney district, Socorro County, N. Mex., in 1904 and 1905.

Year.	Gold.		Silver.		Copper.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine oz.		*Fine oz.*		*Pounds.*		
1904	2,993.45	$61,880	79,014	$45,704	422,308	$54,900	$162,484
1905	4,700.02	97,158	240,943	145,530	295,175	46,047	288,735

OREGON.

By Charles G. Yale.

PRODUCTION.

According to direct returns from the producers the State of Oregon yielded in 1905 the sum of $1,405,235 in gold and $54,744 in silver, a decrease from the output of 1904 of $6,951 in gold and $20,540 in silver. The copper yield was 846,815 pounds, valued at $132,102, an increase of 577,305 pounds, worth $97,090. The lead yield was nominal—only 1,610 pounds worth $75—, and the platinum produced was 118 ounces, worth $2,000, or $88 more than in 1904. The total metalliferous yield of the State for the year was $1,594,156, an increase of $69,452 over 1904, this being wholly due to the copper. The output of precious metals was derived from 233 mines, of which 66 were deep mines and 167 placers. Of the deep mines, 63 produced chiefly gold, 1 chiefly silver, 2 copper, and the lead came from association with silver. Of the 167 placer mines operating, 104 were hydraulic, 2 drift, and 61 were surface mines using sluices, etc. Reports were received from 751 nonproducing and 233 producing mines of all classes.

The 66 deep mines of the State produced in the year 150,268 tons of ore, of an average value per ton in gold and silver of $8.03 and a total average value of $8.91. From this ore came $1,339,362, which includes $352,117 from 6,132 tons of concentrates, and $3,000 from 1,800 tons of old tailings treated, all this including gold, silver, copper and lead. The gold alone from the deep mines amounted to

$1,153,616, the silver to $53,569, the copper to $132,102, and the lead to $75. Nearly all the deep-mine gold came from siliceous ores, except a small quantity from copper ores in Josephine County. The same may be said of the silver, with the addition that a small quantity of it was obtained from lead ores. The deep mines increased $90,644 in gold; $97,090 in copper; decreased $21,660 in silver, and $235 in lead.

The 167 placer mines reporting product show yield of $251,619 in gold, of which $227,040 came from hydraulic mines and $24,579 from surface and drift mining operations. Only a small amount of silver—1,945 ounces—came from the placers. All the platinum was derived from the surface gold-bearing deposits, either the black sands of the ocean beaches or from the hydraulic mines. The placer production was much reduced in 1905, many small properties not being operated owing to shortage of water. More placers were worked in Josephine than in any other county, and the yield of gold in that county was the largest from this source. The decrease for the year from placers was $97,595 in gold.

There were no special changes in smelting features in Oregon in 1905, except that the Takilma smelter was more largely operated than in the previous year, even though the coke supply was scarce. The most productive county in the State is Baker, with an output for the year of $805,423, followed by Josephine and Lane counties, with $538,361. The only other county in the State which yielded over $100,000 was Grant, the others all showing a less output than those figures indicate.

The following table gives in a condensed form a statement of comparative output of Oregon mines in the years 1904 and 1905, with amount of increase or decrease in quantity and value:

Production of gold, silver, and associated metals in Oregon in 1904 and 1905.

	1904.		1905.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold..........fine ounces..	68,314.44	$1,412,186	67,978.23	$1,405,235	− 336.21	−$6,951
Silver..................do....	132,077	75,284	90,636	54,744	− 41,441	−20,540
Copper ....pounds..	269,510	35,012	846,815	132,102	+577,305	+97,090
Lead ....do....	8,621	310	1,610	75	− 7,011	− 235
Platinum...crude ounces..	112	1,912	118	2,000	+ 6	+ 88
Total..................	....	1,524,704	....	1,594,156	....	+69,452

The following table gives the output, by quantity and value, of the respective counties of the State for 1905:

Production of gold, silver, copper, lead, and platinum in Oregon in 1905, by counties.

County.	Gold.		Silver.		Platinum.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*		*Crude ozs.*	
Baker........................	37,326.50	$771,607	55,161	$33,317	....	....
Coos and Crook..................	66.76	1,380	21	13	40.5	$680
Curry	382.69	7,911	62	37	14.0	243
Douglas.........................	897.54	18,554	1,404	848	2.5	40
Grant	4,268.90	88,246	24,755	14,952	....	....
Jackson.........................	4,358.59	90,100	897	542	....	....
Josephine and Lane	19,446.05	401,986	6,471	3,908	60.0	1,020
Malheur	894.70	18,495	132	80	....	....
Union and Wheeler...............	336.50	6,956	1,733	1,047	1.0	17
Total........................	67,978.23	1,405,235	90,636	54,744	118.0	2,000

Production of gold, silver, copper, lead, and platinum in Oregon in 1905, etc.—Continued.

County.	Copper.		Lead.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
Baker	3,200	$499			$805,423
Coos and Crook					2,073
Curry					8,191
Douglas					19,442
Grant	1,000	156			103,354
Jackson					90,642
Josephine and Lane	842,615	131,447			538,361
Malheur					18,575
Union and Wheeler			1,610	$75	8,095
Total	846,815	132,102	1,610	75	1,594,156

The differences between the year 1905 and the preceding year, with the increase or decrease in each county, are shown in the table which follows:

Increase (+) or decrease (—) in metallic production of Oregon in 1905 as compared with 1904, by counties.

County.	Gold.		Silver.		Copper.		Lead.		Platinum.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*		*Pounds.*		*Pounds.*		*Crude ounces.*	
Baker	− 929.77	−$19,221	−22,655	−$11,038	+ 1,400	+ $267	−8,121	−$290		
Coos and Crook	− 153.25	− 3,168	− 1,743	− 993					+8.5	+$130
Curry	− 71.74	− 1,483	+ 61	+ 37					−3.5	− 60
Douglas	+ 470.98	+ 9,736	+ 1,404	+ 848						+ 1
Grant	+ 288.61	+ 5,966	−26,854	− 14,465	− 3,710	− 434	− 500	− 20		
Jackson	− 892.67	− 18,453	+ 737	+ 451						
Josephine and Lane	+1,369.79	+ 28,316	+ 5,796	+ 3,523	+579,615	+97,257				+ 500
Lincoln	− 26.12	− 540								− 500
Malheur	− 221.27	− 4,574	+ 115	+ 70						
Union and Wheeler	− 151.42	− 3,130	+ 1,698	+ 1,027			+1,610	+ 75	+1.0	+ 17
Wallowa	− 19.35	− 400								
Total	− 336.21	− 6,951	−41,441	− 20,540	+577,305	+97,090	−7,011	− 235	+6.0	+ 88

By this it is seen that the counties showing increase in gold output are Douglas, Grant, Josephine, and Lane. The largest decrease in gold is shown in Baker and Jackson counties. Six counties show a slight increase in silver output, and three show a decrease. In copper the principal increase is from Josephine and Lane counties, and the largest increase in platinum is from the same source.

The following table is an analysis, by counties, of the tonnage and average values of the deep mines, with their number and the increase or decrease for the year:

Tonnage of ore sold or treated, number of producing mines, and tenor of ores in Oregon in 1904 and 1905.

County.	Total tons of ore sold or treated.		Number of deep mines producing.		Average total value per ton.		Average value per ton in gold and silver.	
	1905.	Increase or decrease compared with 1904.	1904.	1905.	1904.	1905.	1904.	1905.
	Short tons.	*Short tons.*						
Baker	75,053	+ 5,080	31	18	$11.20	$10.39	$11.19	$10.38
Coos and Crook		− 351	3		3.09		3.09	
Curry	25	+ 25		2		50.40		50.40
Douglas	207	+ 207		3		66.41		66.41
Grant	12,662	+ 1,563	20	11	8.10	6.25	8.05	6.24
Jackson	5,919	+ 4,430	8	8	15.72	7.78	15.72	7.78
Josephine and Lane	53,207	+18,380	19	19	7.58	7.81	6.60	5.34
Malheur	3,179	− 271	3	4	3.92	.90	3.92	.90
Union and Wheeler	16	+ 16		1		68.44		63.75
Total	150,268	+29,079	84	66	9.68	8.91	9.39	8.03

From the above table it may be seen that while there were eighteen fewer in number of deep mines worked in 1905 than in the preceding year, there were 29,079 more tons of ore produced, the larger proportion of increase of tonnage coming from Josephine and Lane counties. In the case of those counties the average total value per ton was slightly raised—from $7.58 to $7.81. Yet the average value per ton in gold and silver shows a reduction of from $6.60 to $5.34. The general average total value per ton fell from $9.68 to $8.91 and the average in gold and silver from $9.39 to $8.03.

As to proportions of concentrates in the ore and old tailings worked, the following table shows results for the year:

Tonnage and value of ore, concentrates, and old tailings in Oregon in 1905.

[Short tons].

County.	Total ore.		Concentrates produced.		Old tailings treated.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Baker	75,053	$779,768	4,996	$299,852		
Curry	25	1,260				
Douglas	207	13,747	22	1,961		
Grant	12,662	79,139	1,009	46,037		
Jackson	5,919	46,024	80	1,820		
Josephine and Lane	53,207	415,472	25	2,447	1,800	$3,000
Malheur	3,179	2,857				
Union and Wheeler	16	1,095				
Total	150,268	1,339,362	6,132	352,117	1,800	3,000

From this table it is seen that about five-sixths of the sulphurets are produced at the mills in Baker County, Grant County coming next, and 3 other counties showing nominal quantities. Old tailings reworked are reported from Josephine and Lane counties, only, and the quantity is small.

The classification and number of deep and placer mines as to production and chief product are shown in the following table:

Number of mines classified by chief product in Oregon in 1905, by counties.

County.	Nonproducing mines.	Gold placer mines.				Deep mines.					Total mines reporting product.
		Hydraulic.	Drift and dredging.	Sluicing.	Total.	Gold.	Silver.	Copper.	Lead.	Total.	
Baker	212	17	....	2	19	17	......	1	....	18	37
Coos	7	....	....	2	2	......	......	......	......	......	2
Crook	6	....	....	1	1	......	......	......	......	......	1
Curry	17	8	....	7	15	2	......	......	......	2	17
Douglas	53	7	....	9	16	3	......	......	......	3	19
Grant	117	11	1	1	13	11	......	......	......	11	24
Harney	5	....	....	....	......	......	......	......	......	......	....
Jackson	96	22	....	9	31	8	......	......	......	8	39
Josephine and Lane	197	31	1	22	54	18	......	1	....	19	73
Lake	1	....	....	....	......	......	......	......	......	......	....
Lincoln	1	....	....	....	......	......	......	......	......	......	....
Malheur	11	2	....	6	8	4	......	......	......	4	12
Marion	9	....	....	....	......	......	......	......	......	......	....
Union	7	....	....	....	......	......	1	......	......	1	1
Wallowa	12	....	....	....	......	......	......	......	......	......	....
Wheeler	....	6	....	2	8	......	......	......	......	......	8
Total	751	104	2	61	167	63	1	2	....	66	233

According to this table 984 mines reported in 1905, of which 751 were nonproducing and 233 were producing. Of the latter, 167 were placers and 66 were quartz mines. All of the latter except 3 have gold as their chief product, 1 having silver as its chief product and 2 copper. There were more productive mines in Josephine than in any other county, there being 54 placers and 15 deep mines in that county. Jackson County, which comes second, has 31 productive placers and 8 productive quartz properties. The third in rank is Baker County, with 37 active mines, 19 placers and 18 deep mines. Baker County has 212 nonproducing mines, which is more than in any other county, and Josephine comes second with 197. Of the placer mines the largest proportion are hydraulic, totaling 104—the largest number being in Josephine County. There are only 2 drift mines, 1 in Grant County and 1 in Josephine County. Of ordinary surface placers there are 61, and 22 of these are in Josephine County, Douglas and Jackson coming second in this respect with 9 each.

The source of the gold product as to placers and kinds of ore in deep mines may be seen in the following table:

Source of gold product in Oregon by kinds of ore in 1905, by counties.

[Fine ounces.]

County.	Placers.	Deep mines.			Total.
		Siliceous ores.	Copper ores.	Total.	
Baker	1,232.40	36,089.00	5.10	36,094.10	37,326.50
Coos and Crook	66.76	....	....	....	66.76
Curry	322.22	60.47	....	60.47	382.69
Douglas	273.12	624.42	....	624.42	897.54
Grant	1,163.76	3,105.14	....	3,105.14	4,268.90
Jackson	2,148.00	2,210.59	....	2,210.59	4,358.59
Josephine and Lane	5,872.23	12,742.98	830.84	13,573.82	19,446.05
Malheur	757.07	137.63	....	137.63	894.70
Union and Wheeler	336.50	....	....	....	336.50
Total	12,172.06	54,970.23	835.94	55,806.17	67,978.23
Increase (+) or decrease (−)	−4,721.15	+3,875.34	+509.60	+4,384.94	−336.21

The siliceous and copper ores show an increase in deep-mine production, and diminution in output for the year of the placer properties makes the total gold output of the State 336 fine ounces ($6,951) less than it was in 1904.

The source of the placer gold product as to character of mines is shown as follows:

Source of placer gold in Oregon in 1905, by counties.

[Fine ounces.]

County.	Hydraulic mines.		Surface placers, drift and dredging.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Baker	1,184.03	$24,476	48.37	$1,000	1,232.40	$25,476
Coos and Crook	....	....	66.76	1,380	66.76	1,380
Curry	213.38	4,411	108.84	2,250	322.22	6,661
Douglas	172.02	3,556	101.10	2,090	273.12	5,646
Grant	1,059.99	21,912	103.77	2,145	1,163.76	24,057
Jackson	2,054.15	42,463	93.85	1,940	2,148.00	44,403
Josephine and Lane	5,456.11	112,788	416.12	8,602	5,872.23	121,390
Malheur	524.87	10,850	232.20	4,800	757.07	15,650
Union and Wheeler	318.50	6,584	18.00	372	336.50	6,956
Total	10,983.05	227,040	1,189.01	24,579	12,172.06	251,619
Decrease	3,189.12	65,925	1,532.03	31,670	4,721.15	97,595

From this table it is evident that all classes of gravel deposits made a smaller yield than in the previous year, due, as has been stated, to a short supply of water during the mining season. Naturally, the hydraulic mines which require the most water show the largest comparative loss, which loss, combined with that of the surface and drift mines, amounts in the total to $97,595 less than in 1904.

The following table shows the details of the silver output of the State with its derivation as to classes of mines:

Source of silver product in Oregon by kinds of ore in 1905, by counties.

[Fine ounces.]

County.	Placers.	Deep mines.				Total.
		Siliceous ores.	Copper ores.	Lead ores.	Total.	
Baker	297	54,864			54,864	55,161
Coos and Crook	21					21
Curry	45	17			17	62
Douglas	15	1,389			1,389	1,404
Grant	262	24,493			24,493	24,755
Jackson	356	541			541	897
Josephine and Lane	793	3,853	1,825		5,678	6,471
Malheur	112	20			20	132
Union and Wheeler	44			1,689	1,689	1,733
Total	1,945	85,177	1,825	1,689	88,691	90,636
Increase (+) or decrease (−)	+1,849	−34,968	−10,011	+1,689	−43,290	−41,441

It appears from this table that the total of silver yield in 1905 was 90,636 fine ounces, or 41,441 fine ounces less than in 1904. Most of the decrease came from the siliceous ores, though the copper ores also show a falling off.

PRODUCTION BY INDIVIDUAL COUNTIES.

BAKER COUNTY.

The total output of Baker County for the year 1905 was $805,423, of which $771,607 was gold, $33,317 silver, and $499 copper. This was $19,221 less gold, $11,038 less silver, and $290 less lead than in the previous year, and $267 more in copper. There were 75,053 tons of ore treated, or 5,080 tons more than in 1904, though 13 fewer quartz mines were operated. There is only a nominal difference in the total average value per ton of the ores in the two years. Nearly 5,000 tons of concentrates were produced from the ores. There were 37 mines producing in the county, of which 19 were placers and 18 deep mines, and there were 212 nonproducing properties which reported. Most of the gold and silver output came from the deep mines. The placers produced $25,476 of the total gold output of $771,607, but virtually all of the silver came from the deep mines.

Cracker Creek or Bourne district.—The most productive district in the county is Cracker Creek, near Sumpter, the comparative output of which is shown as follows:

Production of gold and silver in Cracker Creek (Bourne) district, Oregon, in 1904 and 1905.

[Fine ounces.]

Year.	Gold.		Silver.		Total value.
	Quantity.	Value.	Quantity.	Value.	
1904	21,772.89	$450,086	25,279	$14,409	$464,495
1905	23,807.45	492,144	25,677	15,509	507,653

All this gold and silver came from quartz properties and was derived from 49,991 tons of ore. The properties producing it were the E. & E., the Columbia, the North Pole, the Mountain View, the Tabor Fraction, the Climax, and the Oro Fino. There are 71 stamps operating in the district and 1 Chile mill. From the ore there were obtained 465 tons of concentrates, valued at $75,923 gold, and $3,549 silver. No old tailings were treated. The most productive mine is the Eastern Oregon Mining Company.

Elkhorn district.—At Baker City, Elkhorn district, the Elkhorn Consolidated Gold Mining Company is at work, as is also the United Elkhorn mines.

The mines adjacent to Burkmont, Cableville, Connor Creek, Durkee, Newbridge, Rye Valley, Weatherby, Geiser, Hereford, Bridgeport, Bear Creek, and Austin are few in number, and are all small producers, except the Imperial mine at Cableville. No production was reported from Cornucopia district. A small quantity of copper was produced from the mines near Burkmont, north of Powder River.

COOS, CROOK, AND CURRY COUNTIES.

The only deep mine operated to any extent in these counties was the Cooley-Miller, at Harbor, in Chetco district, Curry County. There are no large placers in any of these counties, but there are quite a large number of small placers in Johnson Creek, Chetco, Mule Creek, Ophir, Sixes River, and Rogue River districts, in Curry County, and also in Coos County, in the Hinch district. Crook County has nothing but a few small placers, none of the quartz mines being operated last year.

DOUGLAS COUNTY.

The only prominent quartz mines in Douglas County are the Tina H. Mining Company, in the Dothan district, and the Continental and Little Chieftain mines, in the Nugget district. There are a number of small placers in Ollala, Perdue, Excelsior, and Green Mountain districts, but there are no large producers.

GRANT COUNTY.

This county in eastern Oregon had a total output of $103,354, of which $88,246 was gold and $14,952 silver. This shows an increase of nearly $6,000 in gold, but a falling off in silver production. There were but 11 producing deep mines, as compared with 20 in 1904, and the grade of ore worked was lower. Of the total gold and silver, $46,037 came from concentrates. There are 11 producing hydraulic mines, 1 drift, and 1 surface placer and these placers yielded for the year $24,057. The placers at Canyon City, Marysville district, produced about $14,000 and were 7 in number. At Granite, in John Day district. the gold yield was $8,045. The quartz mines are at Comer, in Quartzburg district; Granite, in the district of the same name; Greenhorn and Susanville. Among the principal ones are the Bull of the Woods mine (Homestake Gold Mining Company) and the Badger, at Susanville; Dixie Meadows and Equity, at Comer. The Ajax and the Blue Bird, at Granite, expect to increase their output in 1906. The Hidden Treasure and the Worley, at Greenhorn, are also producers. There are 5 companies using stamp mills, 2 roller mills, and 1 set of Tremaine batteries in the county.

JACKSON COUNTY.

Jackson has no very large producers, but the total output of the county was $90,642, nearly all gold. There are 39 mines reporting production, of which 31 are placers and 22 of these are hydraulic properties. The largest producing deep mine is the Opp Consolidated Mines, at Jacksonville. Other prominent ones are the Bill Nye Gold Mining Company and the Pacific American, at Gold Hill, in Galls Creek district; the Corporal G., at Gold Hill, and the Enterprise Mining Company, in

Wimer District. The largest producing placer section is near Jacksonville, called the Southern Oregon district, where the principal producers are the Spaulding Vance hydraulic and the Sterling. In the Foots Creek district, there are a number of small producers. The same is the case at Phoenix, Sams Valley, Applegate, and Wimer.

JOSEPHINE AND LANE COUNTIES.

In this report these counties are combined to avoid divulging private operations in one of them. Next to Baker County the operations are more extensive than elsewhere in Oregon, the total output for the year being $538,361. Of this $401,986 was in gold, $3,908 in silver, $1,020 in platinum, and $131,447 in copper. With the exception of a few hundred pounds from Baker and Grant counties, all the copper in the State in 1905 came from these counties. There was an increased output for the year of $28,316 gold, $3,523 silver, $97,257 copper, and $500 platinum, showing quite a marked advance in the yield from mining operations.

Of the 53,207 tons of ore worked, yielding $415,472, only about 25 tons of concentrates were obtained, worth $2,447, and 1,800 tons of tailings were treated, which yielded $3,000. This was 18,380 tons more ore than was worked in 1904 from the same number of deep mines, and there was only a few cents difference in the average total value; but the average value in gold and silver per ton was $5.34, as against $6.60 in 1904. There were 19 deep mines operating in the 2 counties, and 54 placer mines, and there were 197 nonproducing mines. Of the placers 31 are hydraulic, 1 drift, and the remaining 22 surface placers. The hydraulic mines yielded $112,788 in gold, and the drift and surface properties $8,602, a total of $121,390 in gold thus coming from placer mines. With the exception of a few hundred ounces the silver was derived from the siliceous and copper ores, and amounted altogether to 6,471 fine ounces.

The principal deep-mine producer in the two counties is the Greenback Gold Mining Company, in Grave Creek district, Josephine County, and it is the largest producer in eastern Oregon as well. Other prominent producers in Josephine County are the American Goldfields Company (Granite Hill mine), in Louse Creek district; the Mountain Lion Mining Company, Missouri Flat district; the Capital City Gold Mining Company, and the Mount Pitt Company, in the Jump Off Joe district. The Queen of Bronze mine, at Waldo, is operated by the Takilma Smelting Company, and produces most of the copper. The operation of the smelter is limited on account of the difficulty of obtaining coke, which must be hauled at certain seasons by wagon from Grants Pass. In Lane County, the larger mines are the Oregon Securities Company and the Vesuvius Gold Mining Company, in the Bohemia district, and the Great Northern Development Company, and the Lucky Boy Mining Company, in the Blue River district. As to placers there are many small producers in Althouse, Sucker Creek, Silver Creek, and Selma districts. In the Galice district the largest producers are the Old Channel Mining Company, the Galice Consolidated, and the Harmon and Green. At Dry Diggings, the Golden Drift Mining Company is the largest producer. In Josephine district, the Morrison and the Wilson are the largest producers. The Steam Beer is the only important producer in Mount Reuben district. In Grave Creek district there are a number of small mines, but the only one making a yield of note is the Columbia Mines Company. The Deep Gravel Mining Company is the most important in Waldo district, being one of the largest hydraulic properties in the State. There are no placers in Lane County.

MALHEUR, UNION AND WHEELER COUNTIES.

Malheur County produced $18,575 in gold and silver, the gold amounting to $18,495. The principal deep mines are the Black Eagle, the Golden Eagle, and the Red, White, and Blue, all near the town of Malheur. The largest placer is the Uncle Sam, at El Dorado.

In Union and Wheeler counties the production is confined to one quartz mine in Union County and a number of small placers in Spanish Gulch district in Wheeler County.

SOUTH DAKOTA.

By Waldemar Lindgren.

PRODUCTION.

The producers reported from South Dakota $6,989,492 in gold and 182,749 ounces of silver in 1905. Compared with the output of 1904, this indicates a decrease of $374,485 in gold and an increase of 21,138 ounces of silver. The precious metals were obtained from 12 placer mines and 20 deep mines. The latter yielded 1,837,411 tons of ore, with an average value per ton of gold and silver of $3.86.

Production of gold, silver, and associated metals in South Dakota in 1904 and 1905.

	1904.		1905.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold..........fine ounces..	356,232.40	$7,363,977	338,116.70	$6,989,492	−18,115.70	−$374,485
Silver..................do....	161,611	92,522	182,749	110,381	+21,138	+ 17,859
Copper ....pounds..	(a)	(a)	38	6	+ 38	+ 6
Total..................	....	7,456,499	....	7,099,879	....	− 356,620

a Not reported.

The important gold-mining industry of the Black Hills remains in a very prosperous condition. The decrease noted is small, and chiefly due to incidental causes relating to the reduction of ores. The output from the free milling ores of the Homestake type will probably be somewhat increased during 1906, while that of the refractory ores treated by the cyanide process will most likely remain stationary. The placer mines in South Dakota reported a production of $9,163, an increase of $5,549 over 1904.

The Golden Reward smelter, as well as that of the National Smelting Company at Rapid City, have remained idle, most of the ores formerly supplied to them being treated by the cyanide process.

A little copper ore and probably also an insignificant quantity of lead ores are shipped from the Black Hills. No lead has been reported to the Geological Survey, but it is possible that a small scattered production of a few thousand pounds may have escaped notice.

The following table shows that Lawrence County contains the chief producing area. Pennington County shows, however, an increase compared with 1904, and will probably increase still further in 1906.

Production of gold, silver, and copper in South Dakota in 1905, by counties.

County.	Producing mines.	Tonnage.	Gold.		Silver.		Copper.		Total value.
			Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
		Short tons.	*Fine oz.*		*Fine oz.*		*Lbs.*		
Custer	5	16	34.16	$706	3	$2	38	$6	$714
Lawrence ..	19	1,826,177	336,481.53	6,955,690	182,597	110,289	....	....	7,065,979
Pennington	8	11,218	1,601.01	33,096	149	90	....	....	33,186
Total .	32	1,837,411	338,116.70	6,989,492	182,749	110,381	38	6	7,099,879

Increase (+) and decrease (—) in production of gold and silver in South Dakota in 1905 as compared with 1904, by counties.

[Fine ounces.]

County.	Gold.		Silver.	
	Quantity.	Value.	Quantity.	Value.
Custer	— 279.84	— $5,785	— 118	— $67
Lawrence	—18,928.93	—391,296	+21,381	+17,993
Pennington	+ 1,093.07	+ 22,596	— 125	— 67
Total	—18,115.70	—374,485	+21,138	+17,859

The number of mines, as well as the tonnage and the average value per ton, are shown in the following table. An increase is noted in tonnage and a slight decrease in the value of the ore, due to improved milling processes. A considerable number of small mines producing in 1904 reported no production in 1905.

In the free-milling group the only large mine closed down was the Clover Leaf; the cause is reported to be difficulties in handling the large quantity of water encountered. On the other hand, the Gilt Edge Maid was added to the list of important producers among the low-grade cyanide properties. The Hidden Fortune suspended operations during the year.

The State mine inspector reports that the producing mines employed 3,547 men during the year.

Tonnage of ore sold or treated, number of deep mines producing, and tenor of ores in South Dakota in 1904 and 1905, by counties.

County.	Total tons of ore sold or treated.		Number of deep mines producing.		Average value per ton in gold and silver.	
	1905.	Increase (+) or decrease (—).	1904.	1905.	1904.	1905.
	Short tons.	*Short tons.*				
Custer	16	— 1,884	1	2	$3.12	$16.06
Lawrence	1,826,177	+25,128	37	15	4.13	3.87
Pennington	11,218	+ 9,707	10	3	6.62	2.49
Total	1,837,411	+32,951	48	20	4.13	3.86

The total number of mines classified according to chief product is as follows:

Number of mines classified by chief product in South Dakota in 1905, by counties.

County.	Mines reporting production.	Gold placer mines.				Deep mines.		
		Hydraulic.	Drift mines.	Surface placers.	Total.	Gold and silver.	Gold and copper.	Total.
Custer	5	....	1	2	3	1	1	2
Lawrence	19	....	....	4	4	15	....	15
Pennington	8	2	1	2	5	3	....	3
Total	32	2	2	8	12	19	1	20

Source of gold and silver production in South Dakota, by kinds of ore, in 1905, by counties.

[Fine ounces.]

County.	Gold.			Silver.		
	Placers.	Deep mines, siliceous ores.	Total.	Placers.	Deep mines, siliceous ores.	Total.
Custer	21.73	12.43	34.16	3	....	3
Lawrence	170.38	336,311.15	336,481.53	18	182,579	182,597
Pennington	251.16	1,349.85	1,601.01	31	118	149
Total	443.27	337,673.43	338,116.70	52	182,697	182,749
Increase (+) or decrease (−)	+268.44	−18,384.14	−18,115.70	....	+21,086	....

To the statement regarding siliceous ores should be added that 249,571 ounces of gold are derived from free milling ores and 88,102 ounces from refractory replacement ores. Of the silver, 76,522 ounces were obtained from free milling ores and 106,175 ounces from the cyanided refractory ores.

PRODUCTION BY COUNTIES.

CUSTER COUNTY.

Custer County is the most southerly of the three producing counties of South Dakota and contains the southern part of the isolated area of pre-Cambrian rocks which forms the center of the Black Hills. A small quantity of gold, $706, was reported from this county in 1905, together with a little silver and copper. Part of the gold was derived from placers along French Creek. There are also a number of lode claims under development, and small shipments were made from two of them. From the Maggie mine some concentrates were shipped, containing copper and gold, and also, it is stated, a large percentage of nickel.

Many claims are located on the Mineral Ridge belt, some 14 miles northeast of Custer, and are being developed by several prospecting companies.

LAWRENCE COUNTY.

The great producing mines are all located in the central part of Lawrence County, and most of them are within a circle with a radius of 10 miles. The northern part of the schist and granite area of the Black Hills is comprised within the southern part of Lawrence County, but contains few deposits. The principal mines are, however, situated within a small projecting area of pre-Cambrian rocks about the town of Lead, or in the Cambrian dolomites and limestones overlying the granites and schists. This district is described by Mr. J. D. Irving, of the United States Geological Survey.[a] The ores in the schists are, in general, free milling of the Homestake type, while those in the limestone are known as refractory siliceous ores, and are either cyanided, smelted, or chlorinated. In the contest between these three modes of reduction, the cyanide process has evidently gained the victory.

Production of gold and silver in Lawrence County, S. Dak., in 1904 and 1905.

[Fine ounces.]

Year.	Gold.		Silver.		Total value.
	Quantity.	Value.	Quantity.	Value.	
1904	355,410.46	$7,346,986	161,216	$92,296	$7,439,282
1905	336,481.53	6,955,690	182,597	110,289	7,065,979

[a] Irving, J. D., Economic resources of the northern Black Hills: Prof. Paper U. S. Geol. Survey No. 26, 1904.

A little less gold was produced in 1905 than in 1904, but the decrease has little significance and was chiefly due to incidents affecting the mills and smelters.

The output of the placers is not large; in 1905 only 170.38 ounces were reported from Bear Gulch, Beaver Creek, and Whitewood Creek.

As is well known the Homestake is the most important mine in the State, and, in fact, by far the largest gold producer in the United States.

The Homestake is a low grade but very large stringer lead deposit in pre-Cambrian mica-schists, quartzites, and amphibolites. Its ores probably average about $4 in gold and a few cents in silver per ton. The mining developments consist of vertical shafts from 600 to 1,450 feet in depth. The reduction plant comprises 1,000 stamps with amalgamation, and a crushing capacity of 4,000 tons per day; also cyanide plants of a total capacity of 5,600 tons per month. Further improvements now under way in the treatment of the slimes consist in cyaniding under pressure and separating the solution from the slimes by filter presses on a large scale. The slimes to be treated are said to contain from 80 cents to $1 in gold per ton. The total product of the Homestake mine since 1878 amounts to about $52,000,000.[a] The published annual report of the company indicates that the production for 1905 amounted to $5,177,073.

The Homestake Extension, the Columbus, the Oro Hondo, and the Clover Leaf mines are nonproducing properties in the same formation and are said to have the same kind of free milling ores. Near Rochford, in the same county, are properties of the same type, but none of them have reported production for 1905.

The siliceous, refractory ores occur in blanket form in the Cambrian limestone and dolomite, and have been formed by replacement of this rock; the mineralization is intimately connected with intrusions of trachytes and trachyte-phonolites of Tertiary age. The richer ores are smelted either in the local smelters or at Denver, while the bulk of the ore, which may average $6 or $7, is treated in large cyanide mills, some of which use dry-crushing and others the wet process. A few companies are, however, treating ore containing only two or three dollars in gold per ton.

The following companies comprise the principal producers in 1905:

Principal producing companies of Lawrence County, S. Dak., in 1905.

Company.	Development.	Reduction plant.
Gilt Edge Maid Mining Co	By shaft 350 feet deep and drifts on two levels; open cuts.	Dry-crushing cyanide plant with rolls.
Spearfish Gold Mining and Reduction Co.	By tunnels in flat limestone	Cyanide plant; capacity, 200 tons.
Alexander Maitland properties	By a vertical shaft and a drift 3,800 feet in length.	40-stamp wet-crushing cyanide plant.
Lundberg, Dorr & Wilson	By tunnels 1,800 feet in length	Wet crushing cyanide plant; capacity, 90 tons.
Clinton Mining and Mineral Co	By tunnels several thousand feet in length.	To custom mill.
Dakota Mining and Milling Co		Wet crushing cyanide mill; capacity, 120 tons.
Golden Reward Consolidated Gold Mining Co.	By vertical shafts, up to 587 feet in depth; about 25 miles of tunnels and drifts.	Dry-crushing cyanide mill; capacity, 200 tons.
Hidden Fortune Gold Mining Co.	Crosscuts and drifts	Wet-crushing cyanide mill; capacity, 250 tons.
Horseshoe Mining Co		Cyanide plant destroyed by fire in 1905.
Imperial Gold Mining Co	By tunnel 2,000 feet long	Dry-crushing cyanide mill; capacity, 150 tons.
Monarch Gold Mining Co	By tunnel 1,150 feet long	Ore sent to smelter.
Portland Mining Co	Tunnels about 2 miles in length.	To smelter and custom mill.
Wasp No. 2 Mining Co		Cyanide plant; capacity, 125 tons.

[a] Economic resources of the northern Black Hills: Prof. Paper U. S. Geol. Survey, No. 26, p. 62.

New cyanide mills are being constructed for the Annie mine of the Reliance Gold Mining Company and the Puritan Company; also for the Victoria and the Eleventh Hour companies in the Spearfish district. The Branch Mint Gold Mining Company completed a large cyanide mill near Galena which is expected to be operated in 1906.

Electric power is to be supplied to the mines in 1906 by the Consolidated Power and Light Company at Pluma, and this, it is hoped, will materially reduce mining and milling costs.

PENNINGTON COUNTY.

This county embraces the central part of the large granite and schist area of the Black Hills, and contains a great number of deposits, most of them little developed. They comprise placers, low-grade copper deposits, and gold-bearing veins, mostly likewise of low grade. The latter two classes are, in all probability, of pre-Cambrian age and the gold deposits of the same general type as the Homestake and the Southern Appalachian veins. Most of the gold veins are reported to be free milling.

The gold production of Pennington County is increasing and in 1905 amounted to $33,096; the quantity of silver produced is insignificant. The placers are found at numerous places along the creeks which traverse the county from west to east, the principal localities being at Mystic on Castle Creek, Rockerville on Spring Creek, and in the Last Chance district. In 1905 the placers produced 251 fine ounces of gold.

The gold veins are widely scattered, but the two principal districts are the Hornblende, near Rochford, and the Keystone, 7 miles east of Hill City. In the former district the Golden West Company has operated the Benedict mine, equipped with a Chile mill and amalgamating plates. Production is also reported from the James Cochran mine in the same district.

At Keystone the Mainstay Gold Mining and Milling Company has a 40-stamp mill with amalgamation and cyanide plant. The Bullion Company is reported to be constructing a mill; the old Holy Terror-Keystone mine is nonproducing at present.

Many prospects are being developed along Spring Creek above and below Hill City. A 10-stamp mill is reported in course of construction on the Clara Belle mine, south of Hill City. Below Mystic on Rapid Creek as far down as Silver City are many prospects which are being developed. Galena and stibnite are reported from the Silver City district, as well as from the Spokane district, 5 miles southeast of Keystone.

Copper ores occur at many places. The Central Black Hills Copper Company is reported to have a body of oxidized ores at Copper Butte, 6 miles from Redfern station.

THE SOUTHERN APPALACHIAN STATES.

By Waldemar Lindgren.

The Southern gold belt comprises an elongated area in Maryland, Virginia, North Carolina, South Carolina, Georgia, and Alabama. Its length is about 700 miles, and its greatest width 170 miles. The gold occurs in placers and quartz veins, in some places also in copper deposits, and is contained in the northeasterly striking schists, slates, and gneisses of the States mentioned. The veins are geologically old compared with the majority of western deposits, and are believed to have been formed in pre-Cambrian times, possibly in part during the early Paleozoic era.

PRODUCTION.

The Southern belt for many years has yielded about $300,000 in gold annually, and it bids fair to continue a similar or a moderately increased production for many years in the future.

The following tables sum up the production of gold and silver in the Southern States. The gold shows little change from previous years, but a substantial increase is shown in the silver production, mainly due to increased yield of the Tennessee copper mines. The tonnage was not estimated in 1904, nor were the number of mines recorded.

Production of gold and silver in Southern Appalachian States in 1905, by States.

[Fine ounces.]

State.	Gold.		Silver.		Total value.	Increase (+) or decrease (−) in value.	
	Quantity.	Value.	Quantity.	Value.		Gold.	Silver.
Alabama	2,009	$41,530	336	$203	$41,733	+$12,230	+ $87
Georgia	4,688	96,910	1,040	628	97,538	+ 10	− 242
Maryland	717	14,821	93	56	14,877	+ 12,421	+ 56
North Carolina	6,080	125,685	20,230	12,219	137,904	+ 1,785	+ 3,635
South Carolina	4,601	95,111	111	67	95,178	− 26,689	− 223
Tennessee	211	4,362	95,522	57,695	62,057	+ 62	+23,359
Virginia	241	4,982	177	107	5,089	+ 1,182	− 3,779
Total	18,547	383,401	117,509	70,975	454,376	+ 1,001	+22,893

Number of producing mines, ore production, and average value of gold and silver per ton in Southern Appalachian States in 1905, by States.

State.	Number of mines.			Ore production from deep mines.	Average value of gold and silver per ton of ore from deep mines.
	Placer.	Deep.	Total.		
				Short tons.	
Alabama	1	2	3	16,525	$2.46
Georgia	12	10	22	16,000	4.18
Maryland		2	2	2,698	5.51
North Carolina	7	16	23	18,831	6.76
South Carolina		2	2	49,493	1.92
Tennessee	1	2	3	399,330	.15
Virginia	3	4	7	800	5.35
Total	24	38	62	503,677	.82

The low average value in gold and silver is due to the copper ores. Of the gold ores proper 96,047 short tons were treated, yielding an average of $3.45 in gold and silver.

Source of gold and silver in Southern Appalachian States in 1905, by States.

[Fine ounces.]

State.	Gold.			Silver.		
	Placers.	Dry or siliceous ores.	Copper ores.	Placers.	Dry or siliceous ores.	Copper ores.
Alabama	50	1,959		5	331	
Georgia	1,451	3,159	78	100	271	669
Maryland		717			93	
North Carolina	484	5,224	372	100	3,000	17,130
South Carolina		4,601			111	
Tennessee	10		201	1		95,521
Virginia	39	202		4	173	
Total	2,034	15,862	651	210	3,979	113,320
Increase (+) or decrease (−)	−466	+929	−415	−90	−21	+34,720

ALABAMA.

PRODUCTION.

During 1905 the State of Alabama produced 2,009 ounces of gold, equivalent to $41,530, and 336 ounces of silver, valued at $203. This represents an increase of $12,230 in gold and of $87 in silver as compared with the production of 1904.

Copper, lead, and zinc are not produced in the State.

Two quartz mines and one placer mine were producers. There was also a scattered production of placer gold which is difficult to reach, but which has been estimated at 50 ounces. Approximately 16,525 tons of ore were treated by the quartz mills with an average extraction of $2.46 per ton.

The gold belt enters Alabama from Georgia along the eastern boundary line, but occupies a much smaller space than in the latter State. The gold-producing counties are Chilton, Clay, Cleburne, Coosa, Elmore, Randolph, Talladega, and Tallapoosa, including an area of about 3,500 square miles. The quartz veins are contained in probably pre-Cambrian schists or gneisses, and have the characteristics of the bedded and lenticular veins of the Southern belt. The course of the veins is usually southwest and northeast, and they occur in several more or less well-defined belts with the same direction. Cleburne County contains the shallow placers of Arbacoochee and Chulafinney, which have been worked in a small way for many years. During 1905 the Clear Creek Gold Mining Company, near Heflin, experimented with a small dredge, but their operations have been discontinued. The quartz mines in the Kemp Mountain and Turkey Heaven districts are idle.

In Clay County the Idaho gold mine has been closed for three years.

Randolph County contains the Pinetuckey mine, which is developed to a vertical depth of 200 feet, and is equipped with a 20-stamp mill. This, too, was idle in 1905.

Tallapoosa County was the scene of more extensive operations along what is known as the Goldville belt. At Hog Mountain the Hillabee Gold Mining Company continued its successful career. The ore is heated in a 75-ton dry-crushing plant, followed by cyanide treatment. The Tallapoosa Mining Company is working in the same vicinity, and joined the ranks of the producers in 1905. A 20-ton amalgamation and cyanide plant is now being erected. The Dutch Bend or Romanoff mine, in the same county, was not operated in 1905. It is equipped with a 20-stamp mill and cyanide plant.

GEORGIA.

PRODUCTION.

It is estimated that in 1905 the State of Georgia yielded 4,688 ounces of gold, equivalent to $96,910, and 1,040 ounces of silver, valued at $628. Compared with 1904, gold increased $10 and silver decreased $242. It is estimated that 12 placer mines and 10 deep mines were in operation, a total of 22. The tonnage from the deep mines is estimated to be 16,000 short tons. It is further estimated that $30,000, or 1,451.25 ounces, of gold were derived from placers; $65,303, or 3,159 ounces, were derived from quartzose ores, and 78 ounces, or $1,612, from copper ores. Of the silver, it is estimated that 100 ounces, or $60, were derived from placers; 271 ounces, or $164, from quartzose or dry ores, and 669 ounces, or $404, are known to be derived from copper ores. In addition the State produced 8,841 pounds of copper and 19,394 pounds of lead.

A considerable number of Georgia producers failed to report their production during 1905, the first year in which the method of direct inquiries has been attempted, and it has proved necessary to complete the returns by estimates.

The gold belt occupies almost the whole of northern Georgia, north of Macon and Milledgeville. The extreme northwestern corner, northwest of Cartersville, is, however, outside of it. In the southeastern half of this gold-bearing area there is only a small number of mines working; these are situated in Wilkes, Lincoln, and McDuffie counties, near the South Carolina boundary line. The veins often contain a large quantity of sulphurets, which are sometimes rich in copper and lead. In Lincoln County the Sale and Lamar mine did development work, while the Pascal was idle. In McDuffie County are the Columbia and the Parks mines. The Seminole mine, in Lincoln County, is developed by two vertical shafts, respectively 220 and 150 feet in depth. The mine is equipped with a 40-ton concentrating mill, a roasting furnace, and a 15-ton blast furnace. Matte, concentrates, and ore were shipped from this mine by Mr. Carl Henrich.

The principal gold belt of Georgia is narrow and well defined; it extends from the North Carolina boundary, in the western part of Rabun County, down to Alabama, through White, Lumpkin, Dawson, Cherokee, Paulding, and Haralson counties. In White County the principal locality is at Nacoochee, where the Blow dredge was working in the Chattahoochee River. A large part of the production was, as usual, obtained from the vicinity of Dahlonega, in Lumpkin County. Reports were obtained from the Crown Mountain Mining and Milling Company and the McAfee-Lind mines, but many others were producing, among them the Dahlonega Consolidated Gold Mining Company and the Standard Gold Mining Company, as well as the dredge boats along the Chestatee River. The total gold production of the county was probably between $40,000 and $50,000. The larger part of the production of Georgia, outside of Lumpkin County, is believed to have been derived from Cherokee County.

A gold-bearing belt of less importance lies some 20 miles to the east of the principal one just described, while many scattered occurrences of gold are found to the west of the main belt in Towns, Union, Fannin, and Gilmer counties.

At Pierceville, near the Tennessee line, copper prospects are found in the same formation which contains the great Ducktown deposits a few miles northward.

MARYLAND.

PRODUCTION.

The State of Maryland produced, in 1905, 717 ounces of gold, equivalent to $14,821, and 93 ounces of silver, valued at $56. Compared with the production of 1904 this represents an increase of $12,421 in gold and $56 in silver. The small quantity of silver reported is contained in bullion derived from amalgamation. No placer mines were operated in the State. A little copper was obtained from working the dumps of the old Liberty mine in Frederick County. Two gold quartz mines were worked, both located in Montgomery County at Great Falls, on the Potomac, about 15 miles above Washington. The Great Falls Gold Mining Company operates the Anderson mine. The Maryland Gold Mining Company is actively developing the Maryland mine from a shaft 180 feet deep, and the ore is milled in a 10-stamp plate amalgamation mill. The gold-bearing quartz forms a number of parallel lenticular veins in sericite schist. The occurrence is of interest as forming the most northerly point of the Appalachian gold belt, which from here almost without interruption extends through Virginia, North and South Carolina, and Georgia, to its southerly end in Alabama. The total quantity of ore treated in Maryland was 2,698 tons, containing an average value of $5.51 in gold and silver per ton, the value latter metal being almost negligible.

NORTH CAROLINA.

PRODUCTION.

From reports from the producers, supplemented by conservative estimates, tne yield of the State of North Carolina in 1905 is placed at 6,080 ounces of gold, equivalent to $125,685, and 20,230 ounces of silver, valued at $12,219. This represents an increase over the production of 1904 of $1,785 in gold and of $3,635 in silver. The reported product for 1905 was $98,685 in gold, to which was added a careful estimate of $8,000 for small placers and $19,000 for unreported small mines.

The gold and silver was produced from a total of 18,831 short tons, of which 3,000 tons are estimated, having an average yield of gold and silver per ton of $6.76. Some of the milling ores yielded as much as $10 or $15 per ton. The copper ores contained approximately 3 to 4 per cent of copper, 40 cents in gold per ton, and 2 ounces of silver per ton.

Of the gold, 484 ounces were derived from placers, 5,224 ounces from quartzose ores, and 372 ounces from copper ores.

Of the silver, 100 ounces were derived from placers, 3,000 ounces from quartzose or dry ores, and 17,130 ounces from copper ores.

The number of mines is estimated to be 23, of which 7 were placers and 16 were deep mines. The reported quantity of copper from the State is 480,000 pounds, equivalent to $74,880.

The condition of the mining industry is satisfactory, although the increase, compared with the preceding year, is small. A number of mines were closed during the year, but this was compensated by increased production in Montgomery and Cabarrus counties.

The gold belt of the Southern Appalachians attains its greatest width in North Carolina. Gold is found in at least 35 counties, leaving as unproductive 62 counties in the eastern third of the State and in a belt along the northwestern boundary. B. C. Nitze[a] divides the general field as follows:

1. *Eastern belt.*—This comprises the counties of Warren, Halifax, Franklin, and Nash, and has no correspondent extension northward into Virginia or southward in North Carolina. Among the placers the Farley dredge is actively working in Nash County, while there is little work being done among the quartz mines, both the Portis and the Mann-Arrington being idle.

2. *Carolina slate belt.*—This belt begins in Granville and Person counties, the copper deposits of which form the extension of those in Halifax County, Va. The Yancey mine, in Person County, is said to have been in operation, but the Blue Wing, in Granville County, was closed.

Nothing has been done recently in Alamance, Orange, or Chatham counties. The most important mines on this belt are in Randolph, Davidson, Montgomery, Rowan, Cabarrus, and Union counties. In Davidson County, the Emmons and the Cid mines, the ores of which carry some copper, were idle. They are owned by the Hercules Gold and Copper Company. The Silver Hill mine, described in detail by Nitze in the report quoted, was not worked. It is one of the deepest mines in the South, being developed by an incline shaft 800 feet in depth. The Silver Valley mine was also idle.

In Montgomery County the Iola mine continued its successful and but recently begun career. It was the largest producer of gold in the State in 1905, and is developed by a vertical shaft 289 feet in depth. The ore is reduced in a 20-stamp mill and a cyanide plant with capacity of 40 tons. In consequence of the great success at the Iola, the Golconda and the Montgomery mines have been opened in the same vicinity.

In Stanley County the Barringer mine, owned by the Whitney Company, was closed after having been worked in 1904.

At Gold Hill, in Rowan County, the Union copper mine was the principal producer of silver and copper in the State, besides yielding some gold. It is owned by the Union Copper Mining Company, and is developed by a vertical shaft 600 feet in depth. The copper belt extends over into Cabarrus County, where the McMakin mine, owned by the Yadkin Mines Consolidated Company, was idle.

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[a] Bull. North Carolina Geol. Survey No. 3, 1896.

In Union County, the most southerly in the State on this belt, the Colossus mine was operated; some smelting ore was shipped, and the cyanide plant, which is equipped with two rolls and three ball mills, was operated part of the time. The mine is developed by a 270-foot nearly vertical incline, but a three-compartment shaft is now being sunk. The Indian Trail mine is located in the same county.

3. *North Carolina igneous belt.*—North Carolina igneous belt adjoins the slate belt on the west, and is developed in Guilford, Davidson, Rowan, Cabarrus, and Mecklenburg counties. The mines are as a rule contained in massive igneous rocks such as granite or diorite, which are believed by Nitze to be intrusive into the slates and schists of the slate belt. The ores often contain copper.

In Guilford County the Fentress mine, owned by the Century Development Company, suspended operations in 1904. Little was done on this belt in Davidson and Rowan counties, but in Cabarrus County the Phoenix mine is located and is at present the largest producer on the belt. The mine is owned by the Miami Mining Company. It is developed by two nearly vertical shafts, 540 and 600 feet deep, and is equipped with a 10-stamp amalgamation and concentration mill. The concentrates are chlorinated.

Mecklenburg County contains a great number of mines, most of which, however, are idle. The St. Catherine-Rudicil Gold Mines Company operated their mines near Charlotte in a small way, and it is stated that it is intended to erect suitable reduction works. The mines have attained a vertical depth of 370 feet. Production was also reported from the Yellow Dog mine.

4. *Kings Mountain belt.*—The gold-bearing veins in this belt, which adjoins the igneous belt on the west, occur in schists and gneisses in Gaston, Lincoln, Catawba, Davie, and Yadkin counties. No production is reported from this belt.

5. *South Mountain belt.*—This belt lies still farther to the west in Burke, McDowell, Rutherford, and Polk counties, and the veins, unusually regular, are contained in gneisses and schists. No production was reported, though several mines were probably worked in a small and intermittent way. In some places gold is obtained as a by-product in washing the sands for monazite.

The western copper belt in the schists of Floyd and Carroll counties, Va., continues into Ashe and Watauga counties of North Carolina, but no deposits of importance are worked. Many scattered gold-bearing veins and placers occur, also, in the southwestern corner of the State in Cherokee, Macon, and Jackson counties. These form the most northerly part of the important Georgia belt, which extends through Lumpkin and Cherokee counties of that State.

SOUTH CAROLINA.

PRODUCTION.

The State of South Carolina produced in 1905, 4,601 fine ounces of gold, equivalent to $95,111, and 111 fine ounces of silver, valued at $67. This represents a decrease of $26,689 in gold and of $223 in silver, as compared with the figures of 1904. Two deep mines contributed to the production, treating a total of 49,493 tons of ore, with an average extraction of $1.92 of gold (with very little silver) per ton. No placer mines were operated in the State, nor was any lead, copper, or zinc produced.

The southern gold belt traverses the State from northeast to southwest and the following counties usually show some production: Abbeville, Anderson, Cherokee, Chesterfield, Greenville, Greenwood, Lancaster, Laurens, Oconee, Pickens, Spartanburg, Union, and York.

The veins are contained in the usual slates and schists, and form several belts, of which the most easterly one is, at present, the one showing the greatest production.

The mines in Abbeville County were closed, as were those of Spartanburg and York No production was reported from the Magnolia and Ferguson mines, and the cyanide plant, operated in 1904 on the latter mine, was closed in 1905. The Brewer mine in Chesterfield County was likewise idle. The two producing mines of the State are the Haile gold mine and the Blackmon mine in Lancaster County. The former continued its well-known successful career. It is working on a large deposit of low-grade pyritic ore contained in a fine-grained white slate, probably a pre-Cambrian highly altered igneous rock. The reduction plant consists of a 60-stamp mill, with plants for amalgamation, concentration, and chlorination. The Blackmon mine is developed by a shaft 113 feet deep and is equipped with a 20-stamp mill and plate amalgamation, but no concentrators.

TENNESSEE.

PRODUCTION.

During 1905 the State of Tennessee produced 211 ounces of gold, equivalent to $4,362, and 95,522 ounces of silver, valued at $57,695. This represents an increase of $62 in gold, and of $23,359 in silver over the production of 1904.

One placer mine and two deep copper mines were worked. The total tonnage of the deep mines was 399,330, and the copper ore yielded an average of 15 cents in gold and silver. Ten fine ounces of gold and 1 ounce of silver were obtained from placers, and 201 ounces of gold and 95,521 ounces of silver were derived from copper ores.

The gold belt of the southern Appalachian States includes only a small part of Tennessee in the southeastern corner of the State. The producing counties are Polk and Monroe, and the deposits form lenticular or bedded veins in the Ocoee slates which traverse the region with northeasterly trend. These slates are believed to be of Cambrian or pre-Cambrian age.

The Coker Creek mines in Monroe county have been worked since 1833, and the total production is considerable, though no exact figures are available. Practically all of the gold has been extracted from placers, but gold-bearing veins in the district are also known. Little active mining was done in the district during 1905, but a notable output is promised for 1906. The Lonsdale Gold Mining Company is prospecting a gravel channel 6 feet thick and 120 feet wide. The Unaka Mining and Developing Company has a hydraulic plant in the same vicinity, and is now building a large dredge. The Coker Creek Mining Company is also doing prospecting work. Important mining operations were conducted in the well-known Ducktown copper district situated in Polk County, near the Georgia State line. Two large companies are operating here—the Tennessee Copper Company, an American corporation, and the Ducktown Sulphur, Copper, and Iron Company, of England. Great lenticular bodies of low-grade copper ores containing pyrrhotite and chalcopyrite with a little gold and silver are embedded in the Ocoee slates, and are mined from vertical or inclined shafts at a maximum depth of 450 feet. The Tennessee Copper Company has four 400-ton furnaces, three 300-ton furnaces, and three converter stands. It ships the metal as Bessemer copper. The Ducktown company smelts the ore in a 600-ton plant to a matte, which is shipped. The small quantities of gold and silver contained with copper are mostly recovered in electrolytic refineries, but the exact quantity is not easily estimated, as a certain part of the copper is used for casting without preliminary refining, and as, moreover, another part is exported to European refineries.

A total of 399,330 tons of ore were mined and 1.8 per cent of copper was recovered. The silver in the pig copper averages 13 to 15 ounces per ton. The gold values of the copper range from 0.02 to 0.04 ounces per ton. Distributing the gold and silver over the whole tonnage of ore, one obtains as the average value per ton of ore 1 cent of gold and 14 cents of silver. This, however, is not quite correct, as some of the copper is not subjected to electrolytic refining, but used for casting purposes.

VIRGINIA.

PRODUCTION.

According to the estimate of the Director of the Mint, the State of Virginia in 1905 yielded 241 ounces of gold, of a value of $4,982, and 177 ounces of silver, valued at $107. Compared with 1904, gold increased $1,182 and silver decreased $3,779 in value. It is estimated that 7 mines were producing, of which 3 were placer mines. The 4 deep mines yielded an estimated tonnage of 800, giving an average of $5.35 per ton in gold and silver. It is further estimated that 39 fine ounces of gold were derived from placers and the remainder from silicious or dry ores. Four ounces of silver, valued at $2, were also probably derived from the placers. The remainder, or 173 fine ounces of silver, valued at $105, were produced from dry or quartzose ores.

The gold production of Virginia is small and scattered, and the returns received from the producers were incomplete. The southern gold belt extends through the State in a south-southwesterly direction from Loudoun and Fairfax counties on the north to Halifax and Pittsylvania on the south. The width is from 20 to 30 miles, and the deposits are, as a rule, lenticular quartz veins in schists. Though the production is small at present the Virginia belt contains many old mines of considerable reputation. A deposit of pyrite is worked by the Cabin Branch Mining Company at Dumfries, Prince William County, near the Potomac River.

In Fauquier County the Liepold mine is worked by the Virginia Mining and Development Company. A 10-stamp amalgamation mill on this property worked some tailings preparatory to opening the mine. The Franklin mine is idle. In 1901 and 1902 Mr. R. W. Petre cyanided about 1,000 tons of tailings from this mine, but had difficulty in getting a satisfactory extraction; this was attributed to the presence of selenium, which dissolves freely in cyanide solution and is precipitated more readily than gold. The deposit is stated to be a strong fissure in diorite, accompanied by an intrusion of diabase, and was worked to a depth of 80 feet for a continuous length of 700 feet.

In Louisa County pyrite deposits are worked near Mineral, 5 miles east of Louisa, by the Armenius Chemical Company, and by the Sulphur Mining Company. The mine of the former company is stated to be 900 feet deep.

In Orange County the Piedmont Mining Corporation proposes to work a number of deposits on Mine Run, in the eastern part of the county.

In Albemarle County the Albemarle Zinc and Lead Company had no production, but continued development work on the Faber mine. The incline shaft is 280 feet deep, and the reduction works consist of a 75-ton dry concentrating plant.

In Fluvanna County the old Moss mine remains idle. The Hughes mine, which is worked by a shaft 110 feet in depth, and is equipped with a 10-stamp mill, with amalgamation, concentration, and cyanide plant, was not a producer. There was little activity in the copper belt of Halifax County at Virgilina, just north of the North Carolina line. The Gold Banks mine is situated in the same vicinity.

A small production of gold was reported from the Brush Creek mine in Floyd County, on the western copper belt. No copper is known to have been produced from this belt in 1905, nor from the prospects at Stony Man, in Page County, near Luray. West of the Floyd County copper belt is the zinc belt of Pulaski, Wythe, and Smyth counties, in which chiefly oxidized zinc ores contained in Cambro-Ordovician limestone are mined. These ores contain no silver.

TEXAS.

By Waldemar Lindgren.

PRODUCTION.

During 1905 the State of Texas produced 387,506 fine ounces of silver, valued at $234,054, and 12 fine ounces of gold, equivalent to $248. Compared with the production of 1904 this represents an increase of 1,930 ounces of silver in quantity and of $20,119 in value, and of 3 ounces of gold, equivalent to $62.

Copper, lead, and zinc are not reported from the State. Mercury ores are mined in Brewster County, but are not accompanied by gold or silver.

Six gold and silver mines are operating in the State, but there is only 1 which is worked on a large scale—the Shafter mine in Presidio County. There are no placer mines in the State. The ore treated amounted to 22,345 tons, and its average value in gold and silver per ton was $10.49, practically the whole of this value representing silver.

El Paso and Presidio were the only counties which contributed to the production. Both of these are in the Trans-Pecos part of the State. The mineral deposits are contained in the scattered ranges, which traverse this region with a general north-south trend. The most common rocks consist of Carboniferous and Cretaceous sediments, such as sandstones and limestones. In places they are broken by intrusive rocks later than the Cretaceous, and the mineral deposits are often connected with these igneous rocks.

El Paso County contains copper prospects in the Guadalupe Mountains, near the New Mexico boundary line, said to occur in Permian limestones. Tin has been found in pegmatite dikes in the Franklin Mountains. The Hazel mine in the Diablo Mountains, 10 miles north of Allamore Station, has been worked in former years and is said to have produced much silver and copper. A number of small mines and prospects are located in Sierra Blanca, and some of these were producers during 1905. The whole of the small gold production of the State came from this district. Presidio County produces silver. The Shafter mine, which has been worked successfully for a number of years, is developed by a vertical shaft 700 feet deep. The ore is reduced in a 15-stamp pan-amalgamation mill.

UTAH.

By V. C. Heikes.

PRODUCTION.

According to returns received from producers the total value of the metal output of Utah for the calendar year 1905 was $25,980,683. Of this total, the gold yield was 248,692 ounces, valued at $5,140,920; and silver, 11,036,471 ounces, valued at $6,666,028, a total value for the precious metals of $11,806,948, which is an increase of $719,348 in value over the production of 1904. The most conspicuous feature in the Utah output in 1905 is in the yield of gold, which surpasses that of all former years. During 1905 there were 2,181,061 short tons of ore mined, milled, shipped, and smelted, having an average total value per ton of $11.90. Of this value the ore averaged in gold $2.35, and in silver $3.06, an average total value for gold and silver of $5.41 per ton. A comparison of these figures with corresponding figures for 1904 shows the value of the total metal output to be increased $3,915,252. The average value per ton of ore in 1904 was $12.85, decreasing in 1905 to $11.90 per ton, a loss of 95 cents in value, caused by the enlarged tonnage of low-grade copper ores. The ore tonnage increased 464,114 short tons; gold increased 46,017 ounces and $951,628 in value; silver decreased 1,012,975 ounces and $232,280 in value; copper increased 10,880,820 pounds and $3,136,342 in value; lead decreased 12,597,755 pounds and $213,535 in value; zinc increased 3,256,888 pounds and $192,817 in value; mercury increased 8,519 pounds and $3,907 in value; iron ore and iron contained in combination ores, sold to smelters for fluxing purposes, increased in total value $76,373.

The total values of silver, copper, lead, and zinc are increased, owing to the advanced prices paid producers for each metal during 1905.

Mercury is given at the selling price reported by the producer. The production for 1904 and 1905 is as follows:

Production of gold, silver, and associated metals in Utah in 1904 and 1905.

Metal.	1904.		1905.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold......fine ounces..	202,675	$4,189,292	248,692	$5,140,920	+ 46,017	+ $951,628
Silver............do....	12,049,446	6,898,308	11,036,471	6,666,028	− 1,012,975	− 232,280
Copper.......pounds..	46,417,234	5,802,154	57,298,054	8,938,496	+10,880,820	+3,136,342
Lead............do....	116,479,764	5,095,989	103,882,009	4,882,454	−12,597,755	− 213,535
Zinc.............do....	73,439	3,672	3,330,327	196,489	+ 3,256,888	+ 192,817
Mercury.........do....	58,981	32,093	67,500	36,000	+ 8,519	+ 3,907
Iron................	....	43,923	....	120,296	....	+ 76,373
Total	....	22,065,431	....	25,980,683	....	+3,915,252

Production of ore in Utah in 1904 and 1905.

	1904.		1905.		Increase.	Decrease, per ton.
	Tons.	Value, per ton.	Tons.	Value, per ton.		
					Short tons.	
Ore output........................	1,716,947	$12.85	2,181,061	$11.90	464,114	$0.95

This statement of production shows the mining industry to be in an exceptionally thriving condition, as heavy increases are recorded for all metals except lead and silver.

The ore tonnage of the State is steadily increasing, and much lower grade ores are being milled or smelted than formerly. This has not materially affected the increase in the total value, but will show in another year to be the chief cause of increase, as it is expected the tonnage output figures of 1905 will be almost doubled for 1906. The tonnage of the State for the past four years, and value in gold and silver of ore sold or treated, is shown as follows:

Total tons of ore sold or treated in Utah in 1902, 1903, 1904, and 1905.

Year.	Short tons.	Gold and silver value.
1902	1,114,785	$9,784,481
1903	1,412,379	10,862,231
1904	1,716,947	11,087,600
1905	2,181,061	11,806,948

GOLD.

The value of the gold production in 1905 was $5,140,920, an increase over 1904 of $951,628, and the largest hitherto recorded for the State. The additional yield was caused by the increased tonnage of auriferous copper ore shipped from the Tintic district in Juab County, and from lead ores of the West Mountain (Bingham) district in Salt Lake County. The Camp Floyd district in Tooele County supplied a substantial increase from ores treated by the cyanide process. Other counties from which satisfactory yields are recorded are Beaver, Piute, Sevier, and Utah. The placer gold industry of the southern counties in 1905 yielded 322 ounces, mainly reported from Grand River in Grand County. Other counties contributing placer gold were Uinta, San Juan, and Garfield.

The following table shows from what kinds of ore the gold product was obtained:

Source of gold production in Utah by kinds of ore in 1905, by counties.

[Fine ounces.]

County.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Mixed ores.			Total.
						Copper-lead-zinc ore.	Copper-lead ore.	Lead-zinc ore.	
Beaver, Piute, and Sevier	....	19,391	1,281	15	95	....	480	....	21,262
Box Elder, Morgan, Millard, Washington, and Weber	....	554	....	18	....	....	....	....	572
Grand, Garfield, San Juan, and Uinta	322	14	....	....	....	....	....	....	336
Juab	....	132	77,610	194	....	....	20,503	1,318	99,757
Salt Lake	....	....	46,912	1,823	....	102	15,751	63	64,651
Summit and Wasatch	....	....	92	13,143	....	1,403	83	86	14,807
Tooele	....	44,292	2	127	....	176	1	223	44,821
Utah	....	....	....	2,485	....	1	....	....	2,486
Total	322	64,383	125,897	17,805	95	1,682	36,818	1,690	248,692

The production of gold in 1904 and 1905, by kinds of ore, is as follows:

Production of gold in Utah in 1904 and 1905, by kinds of ore.

[Fine ounces.]

Year.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Mixed ores.			Total.
						Copper-lead-zinc ore.	Copper-lead ore.	Lead-zinc ore.	
1904	65	58,803	92,271	3,468	6	2,552	45,428	82	202,675
1905	322	64,383	125,897	17,805	95	1,682	36,818	1,690	248,692
Increase (+) or decrease (−)	+257	+5,580	+33,626	+14,337	+89	−870	−8,610	+1,608	+46,017

SILVER.

The total silver production for the State amounted to 11,036,471 ounces, valued at $6,666,028 in 1905, as against 12,049,446 ounces, valued at $6,898,308 in 1904, a decrease of 1,012,975 fine ounces in quantity, and of $232,280 in value. The greater part of the year's supply came as before from Summit and Wasatch counties, but the output from these counties decreased. They produced 5,814,386 ounces, valued at $3,328,736 in 1904, as against 3,998,165 ounces, valued at $2,414,891 in 1905, a decrease of 1,816,221 fine ounces in quantity and of $913,845 in value.

Most of the larger mines in the last-named counties have been restricted in their output of silver-lead ore on account of the abundance of water in the lower levels. This will be obviated as soon as the great Ontario drain tunnel is completed. The silver-lead producers of the State filled the front rank of dividend payers a few years ago. Now the only silver-lead mines in this class are located at Park City. The next year will probably add some new producers of silver-lead, but the copper mines are coming to the front so rapidly that they are likely to retain their supremacy.

Source of silver production in Utah by kinds of ore in 1905, by counties.

[Fine ounces.]

County.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Copper-lead-zinc ore.	Copper-lead ore.	Lead-zinc ore.	Total.
Beaver, Piute, and Sevier	......	61,132	33,181	1,400	18,108	....	129,623	....	243,444
Box Elder, Morgan, Millard, Washington, and Weber	......	26,309	2,620	2,570	....	....	....	....	31,499
Grand, Garfield, San Juan, and Uinta	61	....	....	....	....	....	....	....	61
Juab	......	6,600	1,656,391	256,169	....	....	1,818,174	159,748	3,897,082
Salt Lake	......	....	608,907	524,664	....	29,250	1,187,643	1,802	2,352,266
Summit and Wasatch	......	....	....	2,094,136	....	1,804,700	64,959	34,370	3,998,165
Tooele	......	456	250	39,474	....	254,908	429	32,039	327,556
Utah	......	....	....	185,962	....	436	....	....	186,398
Total	61	94,497	2,301,349	3,104,375	18,108	2,089,294	3,200,828	227,959	11,036,471

The production of silver in Utah in 1904 and 1905 is as follows:

Production of silver in Utah in 1904 and 1905, by kinds of ore.

[Fine ounces.]

Year.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Copper-lead-zinc ore.	Copper-lead ore.	Lead-zinc ore.	Grand total.
1904	......	161,209	2,386,794	1,147,565	1,176	3,296,960	5,019,274	36,468	12,049,446
1905	61	94,497	2,301,349	3,104,375	18,108	2,089,294	3,200,828	227,959	11,036,471
Increase (+) or decrease (−)	+61	−66,712	−85,445	+1,956,810	+16,932	−1,207,666	−1,818,446	+191,491	−1,012,975

In these two preceding tables—one for the source of gold, the other for the source of silver—the figures are based on the predominating base metals reported in connection with gold and silver. These figures are only approximations and can not be depended on for each year. A mine may have several shoots of ore. One may be prolific in certain metals one year, another year the ore bodies richer in other metals may furnish the gold and silver.

COPPER.

The wonderful development of the copper industry has had a most marked effect upon mining in Utah, and the State is becoming one of the large producers of the United States. The output for the State increased from 46,417,234 pounds, valued at $5,802,154, in 1904 to 57,298,054 pounds, valued at $8,938,496, in 1905, an increase of 10,880,820 pounds in quantity and of $3,136,342 in value.

West Mountain (Bingham) district, in Salt Lake County, leads in production, and the development of the enormous low-grade deposits of this district proves the field of great importance. The copper output of the district increased from 30,628,834 pounds, valued at $3,828,604, in 1904 to 39,219,734 pounds, valued at $6,118,279, in 1905, an increase of 8,590,900 pounds in quantity and of $2,289,675 in value.

The Tintic district, in Juab County, is the next largest producer. The output increased from 9,035,720 pounds, valued at $1,129,465, in 1904 to 10,982,751 pounds, valued at $1,713,309, in 1905, an increase of 1,947,031 pounds in quantity and of

$583,844 in value. This increase is chiefly attributable to the ores produced by the Centennial-Eureka mine.

The other counties increasing the copper output over 1904 are Beaver, Tooele, and Utah. Decreases were recorded in Summit and Wasatch counties and also in Washington County, the latter on account of the closing of the Dixie mine of the Utah and Eastern Company, resulting from the caving in of the shaft.

LEAD.

The lead produced in Utah decreased from 116,479,764 pounds, valued at $5,095,989, in 1904, to 103,882,009 pounds, valued at $4,882,454, in 1905, a total decrease of 12,597,755 pounds in quantity and of $213,535 in value. This reduction in the output has been general in all the counties, with the exception of Salt Lake County, which increased from 6,394,388 pounds in 1904 to 25,197,137 pounds in 1905, an increase of 18,802,749 pounds.

West Mountain (Bingham) district, in Salt Lake County, contributed the greatest amount to the increase in the production of lead, which came from the properties of the United States Smelting and Refining Company. The Ontario drain tunnel disaster in Uinta (Park City) district, of Summit County, cut down the output of the Ontario and the other lead-silver mines in that district. In Tooele County, at Stockton, considerable development work was done on several lead properties, and the production was limited, pending the completion of the Honorine drain tunnel, through which in the future the ore will be sent to the surface.

Tintic district, in Juab County, shows a decrease of lead.

ZINC.

The only zinc ore produced and shipped in 1904 came from the Horn Silver mine, in Beaver County. During 1905 this mine continued to ship zinc ore, most of it going to Iola, Kans. Shipments were also begun from Park City by two properties to the Western Ore Separating Company, of Salt Lake City, operated by the Lanyon Zinc Company, and also to the United States Zinc Company at Pueblo, the property of the American Smelting and Refining Company.

One mining company at Park City has been experimenting on zinc-lead ores occurring as sulphides at a depth of 1,700 feet. A product containing 40 to 50 per cent has been made by water concentration, but it has been found more economical thus far to make for shipment a product containing 25 to 30 per cent of the metal. The larger part of such product has been shipped to the Western Ore Separating Company, and has been made into richer zinc concentrates by use of the Blake-Morscher electrostatic separating process. This process not only removes the iron minerals from zinc blende, but also the lead and copper minerals. The lead-iron product is shipped to the local smelters, and the zinc concentrates are forwarded to the Lanyon Zinc Company's works, at Iola, Kans.

Producers in Utah reported for 1905 a total of 18,397,092 pounds metallic zinc, of which only 3,330,327 pounds were paid for, resulting, at the average commercial price, in the sum of $196,489. Some producers in Juab, Summit, and Tooele counties report a large quantity of zinc contained in lead ores shipped to smelters. This zinc is a detriment to successful lead smelting. Therefore all ores containing over 10 per cent of zinc are penalized. At the present time reports indicate that more zinc will be saved through improved concentration methods, and that the metal will become quite an item in the State production.

MERCURY.

The only producer of mercury reporting in Utah is located in Tooele County, at Mercur. The output increased from 58,981 pounds, valued at $32,093, in 1904, to 67,500 pounds, valued at $36,000, in 1905, an increase of 8,519 pounds, valued at $3,907.

IRON.

The iron reported is associated with or combined in copper and lead ores and concentrates, and where it exceeds a certain percentage over the silica contents, and in some instances over the total of the silica and zinc contents, it is paid for by the smelters as flux. The sum realized on such iron amounted to a total of $120,296, an increase over 1904 of $76,373. The counties reporting iron in combination with ores, in order of the value of their production, are Juab, Tooele, Salt Lake, and Morgan.

MINING INDUSTRY IN UTAH IN 1905.

Extensive smelter construction was a feature of the year. In Salt Lake County, at Garfield, on the shores of the Great Salt Lake, the Garfield Smelting Company has started the erection of a copper smelter of 6,000 tons daily capacity, which will equal the present capacity of all the Utah smelters combined. Every smelter in Utah has either increased or is now increasing its capacity. The new 400-ton copper smelter of the Utah Smelting Company will soon be completed at Ogden. All these additions will make the State a most important smelting center.

The United States Smelting and Refining Company and the American Smelting and Refining Company are the largest purchasers of lead and copper ores. The Bingham Consolidated copper smelter is supplied with copper ore by its own properties, and also does a custom business to a limited extent.

Most of the smelting ores treated by Utah smelters are produced in the State. However, some rich lead ores are shipped from Idaho, and some gold-bearing siliceous ores from Nevada. Other States contributing in 1905 were California, Montana, and Wyoming.

Smelting establishments.—The present smelting facilities consist of 7 smelting establishments, containing 31 furnaces of large capacity. From 5,000 to 6,000 tons working charge are treated daily at these works, which, briefly described, are as follows:

American Smelting and Refining Company smelter at Murray, 9 miles from Salt Lake City, is equipped with 12 reverberatory furnaces and 8 blast furnaces, which average about 1,600 tons smelting charge per day. About 900 men are employed.

United States Smelting and Refining Company is at present treating daily about 1,000 tons of copper ore and 450 tons of lead ore, with 6 blast furnaces for copper and 3 for lead ores. In the lead smelter there are 15 hand reverberatory roasters. The bessemerizing department in the copper smelter has 2 stands of converters. About 700 men are employed. The plant is located 12 miles south of Salt Lake City.

Bingham Consolidated Mining and Smelting Company has 5 blast furnaces, smelting about 600 tons copper ore daily and using a semipyritic smelting process. The converter plant has six 10-ton shells, 7 feet by 10 feet 6 inches, with two stands. This plant is located at West Jordan, Utah.

Utah Consolidated Mining Company handles at its plant about 800 tons copper ore a day, coming from the Highland Boy mine, owned by the company, at Bingham. The plant is equipped with 20 McDougal calciners, 3 Wethey calcining furnaces, and 9 reverberatory furnaces. About 750 men are employed. The smelter is located near Bingham Junction.

The Yampa Smelting Company, in Lower Bingham, treats about 400 tons of copper ore from mines operated by the Tintic Mining and Development Company, smelting coarse ore in blast furnaces and roasting fine ore, thus making calcines for the reverberatory furnace. The main equipment consists of 2 blast furnaces, 2 roasters, and 1 reverberatory. The plant is to be equipped to handle 800 tons of copper ore per day.

The Utah and Eastern Mining Company's copper smelter at Shem, Washington County, is equipped with 2 water-jacket blast furnaces, each of 50 tons capacity.

The Majestic Copper Mining and Smelting Company owns a copper-lead plant at Milford, but did not operate during the year. The smelter consists of two 100-ton blast furnaces, one for copper, the other for lead.

Milling plants.—During the year several new mills have either been contemplated or put under construction, and a number of plants have been remodeled and increased in capacity.

The Western Ore Separating Company, a company controlled by the Lanyon Zinc Company, of Iola, Kans., erected a mill in Salt Lake City, with the purpose of buying and treating zinc-lead ores and tailings. The process employed for the separation of the zinc and lead is by using static electricity over Blake-Morscher machines. The present capacity of the plant is 60 tons, and the product worked upon is mainly from Park City. By the addition of concentrating tables, with which the plant is being equipped, it will be possible to treat 100 tons daily. With this new company operating in the State, the zinc production has been greatly stimulated.

At Bingham, in Salt Lake County, the Wall mill, of 300 tons capacity, was completed. The New England and also the Utah Copper Company's plants were enlarged. The Sevier Consolidated Company's mill, in the Gold Mountain district in Piute County, was remodeled; also the Annie Laurie Company in the same region made some radical changes in method and enlarged its mill. Changes were made in the Daly-Judge plant, in Summit County, at Park City; in the Columbus Consolidated, in Salt Lake County, at Alta; and in the Cactus mill, belonging to the Newhouse Mines and Smelter Company, in Beaver County, at Newhouse. A new mill is nearing completion on the Godiva mine, in the Tintic district of Juab County; and plans for a concentration mill have been prepared for the Yankee Consolidated, in the same district, to be built early next year. Construction has been ordered to begin on the first unit of 3,000 tons of the concentration plant for the Utah Copper Company. This plant is to be enlarged eventually to three more units of the size stated. It is to be supplied with ore from the company's immense ore deposits at Bingham camp. The site selected for the plant is near the western borders of Salt Lake County, and 4 miles southeast from the new smelter being constructed by the Garfield Smelting Company, near the shores of the Great Salt Lake, at Garfield.

Transportation.—In the early part of 1905 the San Pedro, Los Angeles and Salt Lake Railroad was completed, which runs from Salt Lake through Los Angeles to San Pedro on the Pacific coast. In Utah the line passes through Tooele, Juab, Millard, Beaver, and Iron counties, and is chiefly beneficial to the Rush Valley (Stockton) mining district in Tooele County, the Tintic in Juab County, and the San Francisco in Beaver County.

The Western Pacific Railway Company is building a line from Salt Lake City to San Francisco. The line in Utah does not come directly in contact with gold or silver deposits. After leaving Salt Lake City it goes around the southern end of Great Salt Lake, just touching the northern end of the Oquirrh, Stansbury, and Cedar ranges. The Oquirrh Range contains the mining districts of West Mountain (Bingham), Rush Valley, Camp Floyd, Ophir, and Tintic; but these are already supplied with transportation by the San Pedro, Los Angeles and Salt Lake Railroad and Rio Grande Western Railroad. The Stansbury and Cedar ranges contain no bodies of mineral, so far as known. The northern extension of the Cedar Range, called the Lakeside Mountains, has good surface showings of argentiferous galena, but no large deposits.

The only developed and known deposits of mineral to be affected by the Western Pacific in Utah are those in the Deep Creek region close to the Nevada line and 40 miles south of the line of the new road. The principal camps at present are Dugway, Fish Springs, Clifton, Dutch Mountain, and Gold Hill.

Production by counties.—Utah has 27 counties. Eighteen of these reported production of gold, silver, copper, and lead in 1905. There are 133 mining districts in the

State. Mine operators reported from 32 of these districts, giving figures for the total output of ore and its contents sold or treated in 1905.

The principal mineral-producing counties are Juab, Salt Lake, Summit, and Tooele. The mining districts West Mountain (Bingham), Tintic, and Camp Floyd are responsible for the largest part of Utah's production.

In the following table is shown the output of gold, silver, copper, lead, zinc, and other metals for the year 1905, by counties:

Production of gold, silver, copper, lead, zinc, and other metals in Utah in 1905, by counties.

County.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*		*Pounds.*	
Beaver, Piute, and Sevier..	21,262	$439,525	243,444	$147,040	3,555,918	$554,723
Boxelder, Millard, Morgan, Washington, and Weber	572	11,824	31,499	19,026	380,574	59,369
Grand, Garfield, San Juan, and Uinta	336	6,946	61	37	....	....
Juab	99,757	2,062,160	3,897,082	2,353,837	10,982,751	1,713,309
Salt Lake	64,651	1,336,455	2,352,266	1,420,769	40,031,373	6,244,894
Summit and Wasatch	14,807	306,088	3,998,165	2,414,891	1,254,153	195,648
Tooele	44,821	926,532	327,556	197,844	1,093,197	170,539
Utah	2,486	51,390	186,398	112,584	88	14
Total	248,692	5,140,920	11,036,471	6,666,028	57,298,054	8,938,496

County.	Lead.		Zinc.[a]		Other metals.[b]		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Pounds.*		
Beaver, Piute, and Sevier.	4,215,716	$198,138	1,358,000	$80,122	6,336	$13	$1,419,561
Boxelder, Millard, Morgan, Washington, and Weber	239,770	11,270	....	....	106,720	464	101,953
Grand, Garfield, San Juan, and Uinta	....	....	....	....	....	....	6,983
Juab	16,049,863	754,344	....	....	10,853,112	60,051	6,943,701
Salt Lake	25,197,137	1,184,265	....	....	2,541,142	9,851	10,196,234
Summit and Wasatch	45,280,817	2,128,198	1,972,327	116,367	....	....	5,161,192
Tooele	8,205,814	385,673	....	....	10,839,364	85,917	1,766,505
Utah	4,692,892	220,566	....	....	....	....	384,554
Total	103,882,009	4,882,454	3,330,327	196,489	24,346,674	156,296	25,980,683

[a] Total quantity of zinc reported paid for in Beaver County is 1,358,000 pounds, valued at $80,122; in Summit and Wasatch counties, 1,972,327 pounds, valued at $116,367.

[b] Total quantity of other metals was chiefly iron associated with the general ores, valued at $120,296. Tooele County figures include 67,500 pounds mercury, valued at $36,000.

The following table is prepared for the purpose of showing the increase and decrease of the metals produced in 1905, as compared with the production of 1904:

Increase (+) and decrease (—) of production of metals in Utah in 1905 as compared with 1904, by counties.

County.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine oz.		*Fine oz.*		*Pounds.*	
Beaver, Piute, and Sevier	+ 2,123	+$43,922	+ 58,723	+$41,287	+ 1,905,131	+ $348,375
Box Elder, Millard, Morgan, Washington, and Weber	— 3,089	— 63,849	+ 2,936	+ 2,674	— 1,343,210	— 156,104
Grand, Garfield, San Juan, and Uinta	+ 326	+ 6,739	— 80	— 44	....	....
Juab	+29,008	+599,778	+ 91,136	+174,933	+ 1,947,031	+ 583,844
Salt Lake	+ 7,953	+164,508	+ 797,657	+530,755	+ 9,166,707	+2,386,811
Summit and Wasatch	+ 1,164	+ 24,087	—1,816,221	—913,845	— 864,299	— 69,159
Tooele	+ 8,064	+166,765	— 91,028	— 41,795	+ 69,372	+ 42,561
Utah	+ 468	+ 9,678	— 56,098	— 26,245	+ 88	+ 14
Total	+46,017	+951,628	—1,012,975	—232,280	+10,880,820	+3,136,342

County.	Lead.		Zinc.		Other metals.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Pounds.*		
Beaver, Piute, and Sevier	— 3,339,934	—$132,422	+1,284,561	+$76,450	+ 6,336	+ $13	+ $377,625
Box Elder, Millard, Washington, and Weber	+ 189,770	+ 9,082	....	....	+ 106,720	+ 464	— 207,733
Grand, Garfield, San Juan, and Uinta	....	....	....	....	....	....	+ 6,695
Juab	— 2,217,300	— 44,844	....	....	+ 8,853,112	+57,051	+1,370,762
Salt Lake	+18,802,749	+ 904,511	....	....	+ 1,945,720	+ 6,917	+3,993,502
Summit and Wasatch	—19,031,742	— 685,476	+1,972,327	+116,367	— 310,858	....	—1,528,026
Tooele	— 6,568,955	— 260,723	....	....	+ 1,948,585	+15,835	— 77,357
Utah	— 432,343	— 3,663	....	....	....	....	—20,216
Total	—12,597,755	— 213,535	+3,256,888	+192,817	+12,549,615	+80,280	+3,915,252

The tonnage of ore sold or treated, the number of deep mines producing, the average total value per ton, and the average value per ton in gold and silver are shown in the following table:

Tonnage of ore sold or treated, number of producing mines, and tenor of ores in 1904 and 1905, by counties.

County.	Total tons of ore sold or treated.		Number of deep mines producing.		Average total value per ton.		Average value per ton in gold and silver.	
	1905.	Increase (+) or decrease (−).	1904.	1905.	1904.	1905.	1904.	1905.
	Short tons.	*Short tons.*						
Beaver, Piute, and Sevier	209,154	+132,462	9	9	$13.58	$6.79	$6.53	$2.80
Box Elder, Morgan, Millard, Washington, and Weber	5,144	− 13,691	9	9	16.44	19.82	4.88	5.99
Grand, Garfield, San Juan, and Uinta	16	+ 11	1	1	57.60	18.06	57.60	18.06
Juab	259,713	+ 4,500	26	32	21.83	26.73	14.26	17.00
Salt Lake	1,038,012	+327,342	23	27	8.72	9.82	2.90	2.65
Summit and Wasatch	228,142	− 21,905	14	14	26.75	22.62	14.44	11.93
Tooele	430,453	+ 34,203	15	15	4.65	4.10	2.52	2.61
Utah	10,427	+ 1,192	5	7	43.82	36.88	19.54	15.72
Total	2,181,061	+464,114	102	114	12.85	11.90	6.45	5.41

Tonnage and value of ore produced, concentrates, bullion, and old tailings in Utah in 1905, by counties.

County.	Total ore.		Concentrates produced.		Gold-silver bullion produced.		Old tailings treated.	
	Quantity.	Total value.	Quantity.	Gold and silver value.	Quantity.	Value.	Quantity.	Gold and silver value.
	Short tons.		*Short tons.*		*Ounces.*		*Short tons.*	
Beaver, Piute, and Sevier	209,154	$1,419,561	16,912	$46,201	73,654	$428,262	....	....
Box Elder, Morgan, Millard, Washington, and Weber	5,144	101,953	4	190	26,905	25,493	....	....
Grand, Garfield, San Juan, and Uinta	16	290	....	....	....	....	....	....
Juab	259,713	6,943,701	1,400	15,035	....	....	530	$1,220
Salt Lake	1,038,012	10,196,234	21,936	128,540	....	....	....	....
Summit and Wasatch	228,142	5,161,192	31,987	928,245	....	....	10,960	26,063
Tooele	430,453	1,766,505	23,182	261,695	44,371	915,581	28,800	43,200
Utah	10,427	384,554	....	....	....	....	....	....
Total	2,181,061	25,973,990	95,421	1,379,906	144,930	1,369,336	40,290	70,483

The reports returned from mining operations in Utah in 1905 numbered 759. Of this number, 631 lode mines and 7 placers reported development and assessment work. The remainder, 121 in number, were producing properties. Of these, 114 were quartz or lode mines and 7 placer mines. In addition, 50 milling and 7 smelting plants were reported. Of the milling plants connected with mines, 24 were operating, 24 were idle, and 2 under construction. Of the smelting plants, 4 were connected with mines. The other 3, each treating ores from connected properties, also treated custom ore.

The following table gives for 1905 the number of mines classified according to their chief product:

Number of mines classified by chief product in Utah in 1905, by counties.

County.	Non-producing mines.	Mines reporting product.	Gold placer mines, hydraulic.	Deep mines. Gold.	Deep mines. Silver.	Deep mines. Copper.	Deep mines. Lead.	Deep mines. Zinc.	Total.
Beaver, Piute, and Sevier	126	9	....	1	3	2	3	....	135
Box Elder, Morgan, Millard, Washington, and Weber	120	9	....	1	3	2	3	....	129
Grand, Garfield, San Juan, and Uinta	32	8	7	1	....	....	....	....	40
Juab	77	32	....	....	2	11	19	....	109
Salt Lake	83	27	....	....	....	10	17	....	110
Summit and Wasatch	59	14	....	....	1	....	11	2	73
Tooele	89	15	....	3	1	2	8	1	104
Utah	52	7	....	....	....	....	7	....	59
Total	638	121	7	6	10	27	68	3	759

REVIEW BY INDIVIDUAL COUNTIES.

BEAVER COUNTY.

San Francisco district.—The Horn Silver Mining Company shipped during 1905 a large tonnage of ore and concentrates containing lead, silver, and copper to the smelter near Salt Lake City and many carloads of zinc ore to Iola, Kans. The Peck mill, completed early in the year to handle the tailings dump, closed down on account of scarcity of water. The Cactus mine and the new 800-ton mill of the Newhouse-Mines and Smelters Company have been operating, but not to their full extent, as the work has largely been experimental. The mine is developed by a 600-foot shaft and a tunnel over a mile in length, connecting with the 600-foot level. Between mine and mill a standard-gage railroad 3½ miles long is operated. The recent discovery of a surface deposit of ore 300 feet long by 180 feet wide, estimated to contain 4,000 tons of ore for every foot of depth, has caused the management to install a steam shovel, which, it is calculated, can be profitably employed to a depth of 100 feet in this deposit. The Frisco Contact Mining Company equipped its property with a heavy hoisting plant. The company's holdings comprise a group of 18 claims on the north extension of the Horn Silver vein, near the town of Frisco. This and the Lulu properties have been developing extensively and may become important producers. The Lulu Mining Company, owning a group of claims near the Horn Silver vein, has a shaft down 450 feet, and is drifting to catch the ore body at one of the faults which is characteristic of the Horn Silver formation.

Beaver Lake district.—The Majestic Copper Mining and Smelting Company operated its smelter, equipped with a 100-ton lead and 100-ton copper furnace, near Milford for a short period on ores from the O. K. mine, located in this district, and the Harrington-Hickory and Hoosier Boy properties, located in the Star district. The deepest workings are 400 feet on both the O. K. and the Harrington-Hickory properties, with drifts aggregating 2,000 feet on each.

Star district.—Shipments were begun from the Burning Moscow mine in September. This property promises to be a steady shipper of ore containing lead, copper, gold, and silver. The Leonora property also produced to a small extent.

BOXELDER COUNTY.

Park Valley district.—The Century Gold Mining and Milling Company ceased to operate the mill on ore from the Century mine early in the year, but it was put into commission for a short time treating ore from the Sunrise, a neighboring property. In the meantime the Century Company did some extensive development work and reported the opening up of new ore bodies in a winze sunk for the purpose. In October the 16-stamp mill was again operating on Century ore. The Sunrise Mining and Milling Company has developments consisting of 2 tunnels 800 feet and 120 feet long. The tests made at the Century mill were so successful that the company is considering the erection of a mill.

GARFIELD COUNTY.

The production credited to this county came from the Colorado River placers. Several valuable deposits are located on the river, but the attention of capital has not yet been turned to this section of country as it has on Snake River in Idaho. The results of tests on Colorado River sands by the Geological Survey show small quantities of platinum, which several operators report making experiments to save.

GRAND COUNTY.

The greatest quantity of placer gold produced in the State was reported from this county, credited with 224 fine gold ounces, won from Grand River by the use of rockers, the black sand being concentrated on Bartlett tables; also by sluicing, the black sand being caught on burlap and the gold being afterwards separated by amalgamation.

Lasal district.—The Wilson Mesa Placer Company has built a ditch to carry the water from Mill Creek to the Wilson Mesa, where a hydraulic plant will be installed to work the 40 acres of placer ground owned by the company. The Tornado Gold Mining Company, in Miners basin, reported a production, the result of a test-mill run in the 5-stamp custom mill located near by. The Interstate Mining, Milling, and Development Company completed a 100-ton cyanide plant in Gold basin. It is reported that the company has spent over $70,000 building roads to and developing its mine, which is connected with the mill by a Leschen automatic aerial tramway.

JUAB COUNTY.

Deep Creek region.—This region, bordering the boundary line between Utah and Nevada, has quite a number of promising mining properties which will attain prominence as soon as the Western Pacific Railroad, commenced during the year, is finished. The region covers a large part of western Tooele County, but as its present principal producer is located in Juab County the country is described under this head.

The mining districts in this region are: Fish Springs, Detroit, and Spring Creek, in Juab County; and Clifton, Dugway, Granite Mountain, Lakeside, and many other points not formed into mining districts, in Tooele County. The only district in 1905 reporting production is Fish Springs. Extensive development has been carried on in the Clifton district of Tooele County.

Fish Springs district.—This district is the smallest in area in this region, and has proven wonderfully rich in silver-lead ores since 1891. The Utah mine and the Galena mine are well developed. The former is a steady shipper of lead-silver ore and a dividend payer. The lowest workings are 800 feet, with several thousand feet of drifts. The company ships its ores by wagon about 60 miles to Oasis, thence over the San Pedro Railroad to the Salt Lake smelters.

Spring Creek district.—Spring Creek district, at the head of Deep Creek Valley, has several valuable mining locations on which mainly assessment work has been done during the year. The Queen of Sheba, a gold producer equipped with a mill, was idle.

Dugway district.—Dugway district is 40 miles west of Johnstons Pass, in Skull Valley, and in the northern part of the Dugway Range there are many claims. The principal claim is the Silver King. The Yellow Jacket and the Harrison have large quantities of low-grade ore exposed. Others are the Buckhorn and the Cannon mines, both having produced considerably in the past.

Detroit district.—Detroit mining district is in the south end of the Dugway Range. The ores contain gold, copper, lead, and iron. Not many years ago the Howard mines produced copper. The smelter connected with the property was closed down owing to the excessive cost of hauling fuel. The Great Northern shows considerable development work. Other claims of record are the Ibex, once a producer, the Keystone, the Klondyke, the Martha, and the Rattler.

Clifton district.—Clifton district is the oldest in the Deep Creek region, dating its first locations back to the White Pine excitement in Nevada. It covers an area about 12 miles square. Gold Hill and Dutch Mountain, in this district, have properties which are extensively developed, showing much wealth in gold, silver, copper, and lead.

Granite Mountain district.—Granite Mountain district lies north of Dugway. Developments have exposed some lead-silver ore.

Lakeside district.—Lakeside district is in a low range skirting the Great Salt Lake. The ore exposed is lead, carrying some silver.

Tintic district.—This district, ranking as the greatest producer of precious metals for 1905, is the most important of the county and State. It is one of the oldest mining districts in Utah, and covers an area about 8 miles in length by 3 miles in width, lapping over into Utah County and taking in several important mines. Mines in this district have been worked continuously during the last forty years, and have added many millions of dollars to the world's supply of precious metals, as well as much lead and copper contained in the ores. The developments in the various mines are extensive. While the general average of the values is maintained at depth, the gold extracted, as compared with the gross output, is constantly increasing. Leasing has been profitable to several mining companies and as well to many local miners.

The district in the earlier days suffered a shortage in the water supply, and for this reason many of the mines were not able to treat the lower-grade ores until in 1893, when the Mammoth Mining Company piped water 20 miles, from Cherry Creek. During the same year this company erected a stamp mill, and was followed by the Eureka Hill Company and the Bullion Beck and Champion Mining Company. These mills were idle during 1905, and the mines were in the hands of lessees who mined and shipped only the richer ores. The Uncle Sam Consolidated and the Godiva Mining companies erected concentration mills and piped water from wells near Homansville, about 2 miles distant. The Yankee Consolidated Mining Company will erect a concentration mill in 1906 and will secure water from the same source.

The San Pedro, Los Angeles and Salt Lake Railroad and the Rio Grande Western Railroad have the hauling of ores to the Salt Lake smelters, although some of the ore went to Colorado and California during 1905. The rate which the railroads are now charging Tintic operators on ore valued above $15 per ton is $2.50 per ton to Salt Lake, on less than $15 per ton it is $1.50. The total tonnage of ore mined, treated, and shipped from the mines and mills in the Tintic district to the smelters during 1905 amounted to 266,761 short tons, valued at $7,125,651, an average value of $26.71 per ton. The production of the total metal yield of Tintic district in gold, silver, lead, and copper in 1904 and 1905 is shown in the following table:

Production of gold, silver, and associated metals in Tintic district, Juab County, Utah, in 1904 and 1905, with increase and decrease.

Metal.	1904.		1905.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold ....fine ounces..	71,967	$1,487,558	100,942	$2,086,656	+ 28,975	+ $599,098
Silver ....do....	3,938,630	2,254,866	3,951,348	2,386,614	+ 12,718	+ 131,748
Copper ....pounds..	9,035,720	1,129,465	10,982,751	1,713,309	+1,947,031	+ 583,844
Lead ....do....	22,122,312	967,851	18,702,573	879,021	−3,419,739	− 88,830
Other metals..................	....	3,000	....	60,051	....	+ 57,051
Total..................	....	5,842,740	....	7,125,651	....	+1,282,911

Production of ore in Juab County, Utah, in 1904 and 1905.

	1904.		1905.		Increase.	
	Short tons.	Value per ton.	Short tons.	Value per ton.	Short tons.	Value per ton.
Ore output..........................	262,680	$22.24	266,761	$26.71	+4,081	+$4.47

The origin of the precious metals by different kinds of ore is shown in the following table:

Source of gold and silver in Tintic district, Juab County, Utah, 1904 and 1905, by kinds of ore.

[Fine ounces.]

Metal.	Year.	Siliceous ore.	Copper ore	Lead ore.	Copper-lead ore.	Lead-zinc ore.	Total.
Gold..........................	1904	513	38,326	1,705	31,422	1	71,966
	1905	132	77,610	1,379	20,503	1,318	100,942
Silver..........................	1904	69,892	1,470,150	497,163	1,900,671	754	3,938,630
	1905	6,600	1,656,391	310,435	1,818,174	159,748	3,951,348

The figures of production in this table show a decrease of gold and silver in siliceous ores. To this column was credited all gold and silver produced from ores having no base metals. At the same time the larger portion of the so-called copper ores may be properly classed in the siliceous-ore column on account of the low per cent of that metal. There was a decrease in lead ores and a corresponding decrease in copper-lead ores, while in zinc-lead ores an increase was recorded, probably caused by lower penalty rates against the zinc.

There were 31 properties reporting as contributors to the output in 1905. This is a decrease of 4 over those reporting for the year 1904. The companies reporting production are named in order of the value of their production, as follows: Centennial Eureka Mining Company, Gemini Mining Company, Mammoth Mining Company, Grand Central Mining Company, Bullion Beck and Champion Mining Company, Uncle Sam Mining Company, Eagle and Blue Bell Mining Company, Eureka Hill Mining Company, Victoria Mining Company, Ajax Mining Company, Victor Consolidated Mining Company, Swansea Mining Company, Ridge and Valley Mining Company, Godiva Mining Company, and other companies.

The Centennial Eureka mine, operated by the United States Smelting and Refining Company, is developed to a depth of 2,023 feet from the surface. It is the second deepest shaft in the Tintic district, the Mammoth being the deepest. The company employs about 300 men. From this mine the railroad companies report moving 3,026 cars of ore to the Salt Lake smelters and elsewhere during 1905. A study of the report shows the ore values to be principally in gold and silver—about 20 ounces of silver to 1 ounce of gold—and that the copper value is nearly equal to the gold value, which shows that there is nearly 5 per cent copper to each ounce of the gold.

The Gemini mine is at a depth of 1,700 feet, with a vertical shaft. Shipments of ore, carrying principally silver values and a good percentage of lead and copper, were shipped to smelters near Salt Lake and in Colorado.

The Mammoth mine is developed by a vertical shaft 2,225 feet deep. It has the distinction of being the deepest mine in the district. Out of a force of 100 men only about 40 are working as "company men," the remainder being all on leases. The large milling plant was idle, the company shipping the low-grade ores to the smelters. A study of the report shows that the greatest value in the ore is copper, and that the value of the gold is nearly equal to it. The proportion of silver is about 22 ounces to 1 ounce of the gold. The lead ore was shipped separately, returning good values in silver, with nominal copper contents. The Cherry Creek water plant, belonging to the company, was rebuilt during the year. This plant supplies water for the town of Mammoth and for use at the hoisting works.

The Grand Central mine has a shaft 1,300 feet deep. Its ores are similar to the Mammoth mine and carry the same metals. The mine is equipped with one of the best hoisting plants in the district, as well as a gravity tramway connecting the mine with the railroad at Robinson. The Bullion Beck and Champion mine is almost entirely worked by lessees, of whom there are about 85. The bulk of the ore mined by lessees has been of a very high grade, containing gold, silver, copper, and lead, the greatest values being in lead and silver, which were nearly equal. The percentage of copper distributed in the total ore is small. A concentration mill is connected with the property, but was idle during the year.

At the Uncle Sam mine enough low-grade ore has been taken from the property to keep the mill in operation. The concentrates, with a high-grade lead ore, are shipped to the smelters. This ore carries gold, silver, and lead.

The Eagle and Blue Bell mine constructed a new ore house and a tramway. Considerable drifting was performed on the 1,000-foot level, and a winze was sunk for another connection between the 800-foot and 1,000-foot levels. The ore carries gold, silver, copper, and lead. This property is controlled by the Bingham Consolidated Mining Company.

The Eureka Hill mine is developed by a 1,500-foot vertical shaft. At the mine is a 100-stamp concentration and pan amalgamation mill, which was idle throughout the year. The greatest value in the ores is silver; to each ounce of silver about 1 pound of copper and 8 pounds of lead are produced. The ore is mined entirely by lessees, the company first adopting the system in the upper workings, and with such satisfactory results that the lower levels were also leased during the latter part of the year. From the tailing dump a few tons of concentrates were produced.

The Victoria mine is operated and developed through the 1,300-foot shaft of the Grand Central, the adjoining mine. The ore is identical with that of its neighbor.

The Ajax mine has a 3-compartment vertical shaft, 1,000 feet deep, with levels at each 100 feet down to 1,000 feet in depth. The total values reported show the ore returns are principally for copper; gold and silver are about equal in value.

The Swansea mine, at Silver City, is developed by a vertical shaft 1,050 feet deep. During the year this mine forwarded to the smelters nearly a carload of ore daily. This was extracted from the upper levels, no work being carried on below the

800-foot station on account of water. The ore is favored by the smelters principally for its iron content. Some silver and a small quantity of gold are also present.

Ridge and Valley mine, lying to the north of the Gemini, is operated through the Gemini shaft. Silver and lead are produced.

The Godiva mine has a vertical shaft 900 feet deep. Its ores contain principally lead, with some silver and a little gold.

Other producing mines reporting were: Yankee, May Day, Beck Tunnel, Tetro, South Swansea, Black Jack, Brooklyn Consolidated, Laclede, Lower Mammoth, Undine, Monterey, Primrose, Showers Consolidated, Garnet, Hope, Argenta, and Albion.

MILLARD COUNTY.

Leamington district.—The Yellowstone group of claims, located in Wood Canyon, was operated and produced several carloads of lead ore taken out in doing assessment work. The development consists of an incline shaft 200 feet deep and drifts about 400 feet long.

MORGAN COUNTY.

Argenta district.—From the claims owned by the Carbonate Hill Mining Company a number of carloads of lead-silver ore were shipped. The property is developed by 3 tunnels, from 150 to 452 feet in length.

PIUTE COUNTY.

Gold Mountain district.—The Annie Laurie Mining Company, located at Kimberly, is the second largest producer of gold in Utah, using the cyanide process. The mill has been improved and is in condition to treat regularly 300 tons of ore per day. The treatment is dry crushing, with a cyanide solution followed by amalgamation Among other improvements was the installation of an auxiliary electric-power plant. The Sevier Consolidated Gold Mining Company closed down the original mill, a 10-stamp affair, in June, and have finished a plant using the cyanide process, which treats more than 100 tons of gold ore per day. The ore is crushed in stamp batteries; and about 25 per cent of the gold is saved on the amalgamated copper plates, after which the cyanide process extracts the remaining values. Developments were made in the mine which made it possible to send the ores to the mill through No. 3 tunnel, the portal of which is at the milling plant.

Ohio district.—The Webster group of claims, owned by the Webster Mining Company, was operated during the year by lessees. The property is opened by a tunnel 2,350 feet.

SALT LAKE COUNTY.

Little Cottonwood district.—The most important developments during the year 1905 were in the Little Cottonwood district, the leading district in production. Alta, the chief camp, is located near the head of Little Cottonwood canyon. The two districts, Little Cottonwood and Big Cottonwood, taken together mined 26,003 tons of ore, valued at $451,975, and averaging in gold, silver, copper, and lead, $17.38 per ton. From part of the ore treated at milling plants 5,719 tons concentrates were produced, valued at $65,271 in gold and silver. The total tonnage of ore mined, including crude ore and concentrates shipped in 1905, shows averages per ton as follows: Gold, 75 cents; silver, $8.63; copper, $4.86; lead, $3.07. The balance was for excess iron. The tonnage of ore shipped in 1905 is an increase in quantity of 21,125 tons and in value of $328,755 over the production of 1904. The average ores of the district rarely contain over 1 per cent copper, but when lead is present as much as 5 per cent copper is found. In average oxidized ore the silver content is from one-half to 1 ounce, and the gold from 0.03 to 0.06 of an ounce, to each unit of lead and copper. The minerals wulfenite, vanadinite, and hubnerite occur in the ores. There are surface deposits of manganese, but no attempt has been made to utilize them for other metals, as the content in silver is very low. The average content of zinc in the ores is low, and rarely goes above 7 per cent. However, heavy deposits of zinc ore are reported to exist in the district. The greatest value in the ores is from the silver content. As compared with other districts, Bingham for instance, it will be seen that the ores of the district are comparatively high grade when $12 ores of favorable composition can be profitably handled on account of low smelting rates. The present average wagon hauling rate is about $3.50 per ton to Sandy, the nearest railroad point. Improved transportation facilities arranged for during 1906 will greatly lower the present rates.

The Columbus Consolidated Mining Company is the largest producer. Its mine is developed by tunnels and winzes, the total aggregating about 10,000 feet. All the crude ore and concentrates produced during the year came as a result of development alone. A concentration mill of 150 tons daily capacity has been, with the exception of the earlier months of 1905, almost continuously in operation.

The Continental Mines and Smelting Corporation, operating the Continental Alta mine, is developed by tunnels aggregating 18,000 feet. The mill is about 5 miles distant from the mine, connected by a single rope aerial tramway. This company secured a lease on the right of way owned by the Rio Grande Western Railway, and will probably undertake the reconstruction of the road from Bingham Junction to Wasatch. Steady development has been going on with the other producers, the City Rocks, the Silver King group, and the Albion. Two old producers of the early days, the Flagstaff and the Emma, may be operated by a new organization known as the Alta Consolidated Mining Company. The South Columbus and Alta-Quincy, the Pioneer Consolidated, and the Kennebec are developing steadily. At the latter property, which is perhaps the largest group in the district, a main tunnel is being driven, and the mine is expected to ship ore in 1906.

Big Cottonwood district—The Maxfield Mining Company is the best developed and practically the only constantly producing property in this district. The company was shipping ore during almost all of 1905. New and improved machinery was installed at the mine, and a Pelton water wheel of 300-horse power will furnish additional power. At the head of the Big Cottonwood Canyon the Great Western Gold Mining Company are driving a tunnel to connect with the ore bodies in the old upper workings of the mine. Some work has been done during the year on all the following properties in the district: Scottish Chief, Bramberg, Mountain Chief, Carbonate, Peruvian Chief, and the mines of the Big Cottonwood Copper and Gold Mining Company and of the Scott Mining and Milling Company.

West Mountain or Bingham district.—The output of milling and smelting ore reported in 1905 by 21 producers was 1,012,009 short tons, valued at $9,744,260, or an average value of $9.62 per ton, in which were contained gold valued at $1.30 and silver at $1.18 per ton. The total tonnage and value represents an increase of 306,217 tons in quantity and $3,694,813 in value. The concentrates, amounting to 16,217 tons, worth $63,269, included in the total value, averaged in gold $2.81 and in silver $1.08 per ton. These values are greater in consequence of the milling of lead-silver ores. The concentrates produced increased 6,702 tons in 1905 over 1904. The low-grade milling ores from the porphyry show an average concentration on the basis of 19 tons into 1. During the year the district mined, milled, and shipped daily 2,772 tons of smelting ores, of which 200 represented lead-silver ore. The remainder was copper-iron ore, having its chief value in copper. The freight and smelting charges on the smelting ores, are from $5 to $6 per ton. The milling ores can be handled for $2.50 to $3 per ton. At one time during the year the smelters were not able to handle all the ore shipped, and it was necessary for the producers to curtail their output temporarily. This was due partly to the lack of capacity at the smelters and at another time was caused by a shortage in the coke supply. Though the production has exceeded that of 1904, it is not as great as it should have been had the smelters taken all the ore offered. The Copper Belt road that winds its way between a number of the mines to the mills and smelters has been found entirely inadequate to handle the great tonnage, and to prepare for the increased output of another year the Rio Grande Western Railway has surveyed a new line to be constructed so as to connect the mines with the new mill and smelter at Garfield, about 15 miles distant. When these great establishments are finished the tonnage of ore daily transported out of Bingham Camp will probably be from 9,000 to 12,000 tons.

Extensive sampling of the mines, testing of ore bodies with diamond drills, and experimental work on the ores have characterized the past year's operations in the district. Another year has the promise of extensive construction and equipment of mines and mills and of the introduction of the steam shovel at one or more of the properties to be used to mine the great ore deposits.

The production of Bingham Camp for 1904 and 1905 is given in the following table:

Production of gold, silver, and associated metals in West Mountain or Bingham district, Salt Lake County, Utah, in 1904 and 1905.

Metal.	1904.		1905.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold..........fine ounces..	56,390	$1,165,685	63,701	$1,316,817	+ 7,311	+ $151,132
Silver................do....	1,440,213	824,522	1,980,583	1,196,272	+ 540,370	+ 371,750
Copper ....pounds..	30,628,834	3,828,604	39,219,734	6,118,279	+ 8,590,900	+2,289,675
Lead ....do....	5,204,383	227,702	23,494,879	1,104,259	+18,290,496	+ 876,557
Other metals.................	....	2,934	....	8,633	....	+ 5,699
Total..................	....	6,049,447	....	9,744,260	....	+3,694,813

Production of ore in Bingham district, Utah, in 1904 and 1905.

	1904.		1905.		Increase.	
	Tons.	Value per ton.	Tons.	Value per ton.	Tons.	Value per ton.
Ore output..................	705,792	$8.57	1,012,009	$9.62	306,217	$1.05

The number of producers or contributors to the 1904 product was 27; for 1905 the number is 21—a decrease of 6. This decrease represents properties changing ownership or operated by the larger companies. An increase in the yield of gold and silver, as shown in the table, comes more particularly from the lead ores whose output was greatly augmented during the year on account of the United States Smelting and Refining Company constructing lead furnaces in its establishment near Salt Lake City, and utilizing the lead ores coming from its properties in Bingham Camp, as well as treating custom ores of the same character. The average copper ores do not carry as much gold and silver as the lead ores. This is shown in the following table, which gives the origin of the precious metals by kinds of ore:

Source of gold and silver in West Mountain or Bingham district, Salt Lake County, Utah, 1904 and 1905, by kinds of ore.

Metal.	Year.	Copper ore.	Lead ore.	Total.
Gold	1904	56,284	106	56,390
	1905	61,828	1,873	63,701
Silver	1904	1,435,469	4,744	1,440,213
	1905	1,454,117	526,466	1,980,583

Production of the precious metals in siliceous ores has not been reported since 1903. The shipping class of copper ore is a copper-iron sulphide. It is composed of chalcopyrite and cupriferous pyrite and of black sulphide of copper, with occasionally a little galena and zinc blende. The lead ore is made up of galena, tetrahedrite, considerable zinc sulphide, pyrite, and chalcopyrite.

It was intended to extend the table by kinds of ore to show the content of the precious metals in copper-lead and zinc-lead ores, but as many large producers who report to the Geological Survey do not segregate the quantities of the two kinds of ore shipped, the difficulty of showing such figures is apparent. However, it is interesting to note that in another year the district will produce in considerable quantity zinc-lead ores, carrying both gold and silver, but mined chiefly for the zinc content.

The producers of the district are: Utah Consolidated Mining Company, United States Mining Company, Utah Copper Company, Bingham Consolidated Mining Company, Tintic Mining and Development Company, Boston Consolidated Mining Company, Bingham and New Haven Copper and Gold Mining Company, Ohio Copper Company, Bingham Copper and Gold Mining Company, Phœnix Mining Company, Fortuna Mining Company, Sampson Mining Company, Utah-Apex Mining Company, New England Gold and Copper Mining Company, New Red Wing Gold Mining Company, Butler Liberal Consolidated Mining Company, Conglomerate Mining Company, Cluster Mining Company, Silver Shield Mining and Milling Company, and the Mystic Shrine, Frieda and Pappea claims. The principal producers of the district are briefly mentioned in the following paragraphs.

The Utah Consolidated Mining Company, according to a published report, "produced during 1905, 286,363 tons of copper sulphide ore, 439 tons of oxidized ore, and 436 tons of lead ore. Development and exploring totaled 12,444 feet." The mine, comprising 239 acres in Carr Fork Gulch, is worked through a system of 6 tunnels. The main outlet is through the lowest tunnel. The ores of the mine are conveyed over a 12,700-foot aerial tramway to the tracks of the Rio Grande Western Railway, and thence over the road to the 800-ton copper smelter, 17 miles distant, south of Salt Lake City.

The United States Mining Company, owning and operating the Old Jordan, Galena, and Telegraph properties, is mining ore at a depth of 400 feet through a system of tunnels. The holdings of this company in Bingham Camp comprise about 1,200 acres of mining land. The ores are mostly copper and lead sulphides, which are conveyed by an aerial tramway about 16,000 feet long to the railway, thence to their smelter near Bingham Junction.

The Utah Copper Company owns about 200 acres of ground lying on both sides of Bingham Canyon, and permitting ore extraction by tunnel to great depth. There are 13 of these tunnels. It has been demonstrated during the year, by drilling tests and by these tunnel openings, that the tract is underlain by enormous quantities of ore, which carries from 0.075 per cent to 3 per cent copper, with an average of slightly under 2 per cent, and about 20 cents in gold and silver. The minerals are chalcopyrite and bornite, disseminated minutely through the rock. The ore is easy to mine, being soft and friable, and owing to the immense exposure of this ore at the surface, it is essentially a quarrying proposition. The company owns a concentration mill of 800 tons daily capacity, about 1½ miles below Bingham. The ores are transported in cars over standard gage tracks from the mine to the mill. Arrangements are being made for working this body of ore by steam shovels. The company has started the construction of a great concentration plant at Garfield, on the shores of the Great Salt Lake, about 16 miles distant. The ores will be transported by the Rio Grande Western Railway.

The Bingham Consolidated Mining Company and the Bingham Copper and Gold Company are practically one, and are known as the Bingham Consolidated Mining and Smelting Company. The company owns about 300 acres of land in the district, consisting of the Dalton and Lark property, the Miner's Dream, the Antelope, the Brooklyn, the Yosemite No. 1, the Commercial, the Sampson, and sundry other mines and claims, besides controlling certain mines in the Tintic district of Juab County. During 1905 the Mascot tunnel, driven for 8,200 feet, cut all the veins which traverse the Dalton and Lark group of claims, and caused the production of a large tonnage of lead and copper ore. The lead ore is shipped to the lead smelter near Murray, and the copper ores, with other copper ores from the Commercial group, to the company smelter at West Jordan, Utah. The Commercial group produced ores containing considerable auriferous galena, also auriferous and argentiferous copper ores. The Sampson likewise produced heavily in ores carrying the same minerals.

The Tintic Mining and Development Company, owning the Yampa group of claims, about 100 acres in area, in Carr Fork Canyon, sells its ores to the Yampa Smelting Company, an allied concern, whose smelter is located below Bingham. The mine is opened by two tunnels. The upper, or Yampa tunnel, is 659 feet below the crest of the mountain. The Craig or lower tunnel cuts the ore body 2,200 feet from its mouth, and at a depth of about 1,800 feet on its strike. The vein is reported to be from 10 to 37 feet in width, carrying disseminated chalcocite, covellite, and chalcopyrite, and giving average returns of 3.5 per cent to 4 per cent copper, and $2 to $3 per ton in gold, with considerable silver values. The smelter has already been briefly described.

The Boston Consolidated Mining Company owns about 300 acres of mining ground, developed by tunnels from 500 to 2,500 feet in length. The regular ore, of which from 200 to 300 tons are shipped daily, is similar in character to the Utah Consolidated, and the milling ores of a porphyry gangue are similar to and average the same as the ores of the Utah Copper Company. The Boston Company has planned the building, near Garfield, of a concentration mill to treat about 5,000 tons of ore daily. The following interesting statement concerning the cost of the treatment of the low grade copper ores was recently published by this mining company:

Contents and cost of extraction of metals, showing net profit per ton.

1.4 per cent copper gives .... pounds..		28
Deduct 25 per cent loss in concentration .... do....		7
Net .... do....		21
21 pounds copper, at 13½ cents		$2.83
Gold and silver, added		.20
Total value, per ton		3.03
Mining cost with steam shovel	$0.40	
Milling cost	.35	
Smelting cost	.25	

2 cents per pound, freight and refining	$0.42	
Loss, smelting expense, selling company	.16	
Working crude ore	.20	
Total expense, per ton		$1.78
Net profit per ton		1.25

As the entire mountain on which this company has located their mining claims seems to be of this low-grade ore, it has been definitely decided to mine it by means of steam shovels, one of which was already on the ground at the close of 1905.

Important developments were recorded by the remainder of the producers. Several new companies have been organized, and important developments may be made during 1906 that will put these companies in the first class.

SAN JUAN COUNTY.

Lasal district.—The principal mining developments of importance have taken place on the Grand County side of the district. The Lasal Mountains are situated in eastern Utah, near the Colorado line. They are in three divisions or peaks, being divided by two passes. The northern pass, through which the dividing line of Grand and San Juan counties runs, is known as Geyser; the southern is called Lasal pass. The only production for 1905 came from placers on the San Juan River, near Bluff City.

SEVIER COUNTY.

Henry district.—The B. W. and H. Mining Company is operating not far from the railroad on a property which has paid almost from grass roots. The management is opening new territory, and the returns on the ore taken out in drifting is applied to development.

SUMMIT AND WASATCH COUNTIES.

The metal output of the two counties came from the Park City mining region, which embraces Uinta district in Summit County, and Snake Creek district, in Wasatch County. The greatest and most productive area of these counties lies in Summit County. Wasatch County records one important producer for the year, with the prospect of having other producers in 1906, both in this district and in a new region on the east side of the county. The Park City camp has been the scene of Utah's greatest mining disaster of the year—the caving in of the great drain tunnel of the Ontario Silver Mining Company in March. This had a serious effect on the camp. The tunnel had reached the 15,200-foot mark when the accident occurred. At the close of the year, efforts were being made to continue the bore which, when completed, will be of service in handling the great flow of water that handicaps some of the large mines of the district. Had this disaster not happened, the output would undoubtedly have surpassed all previous records. The district has, however, kept up to nearly its normal tonnage, and paid dividends during the year aggregating $1,632,000. The ores mined are essentially argentiferous lead ores, with accessory gold and copper, and a siliceous gangue.

Ores milled or shipped direct to smelters during 1905 from the district amounted to 228,142 short tons, valued at $5,161,192, an average value per ton of $22.62; in 1904 the mines yielded 250,047 tons of ore—a decrease for 1905 in quantity of 21,905 tons and in value of $1,528,023, due almost entirely to decreased output of silver and lead. Concentrates were shipped amounting to 31,987 short tons and valued at $928,245, in gold and silver, the value in gold being $75,992, or $2.38 per ton, and in silver, $852,253, or $26.64 per ton. No bullion was produced. From 10,960 tons of old tailings, free gold and concentrates were shipped valued in gold and silver at

$3,523. According to these total figures the output of ores for 1905 yielded per ton: gold, $1.34; silver, $10.59; lead, $9.33. As but few of the mines shipped ore containing pay copper or zinc, the averages of these two metals are not given. The production of metals in the district in 1904 and 1905 is shown in the following table:

Production of gold, silver, and associated metals in Park City mining region, Summit and Wasatch counties, Utah, 1904 and 1905.

Metal.	1904.		1905.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold..........fine ounces..	13,643	$282,001	14,807	$306,088	+ 1,164	+ $24,087
Silver ....do....	5,814,386	3,328,736	3,998,165	2,414,891	− 1,816,221	− 913,845
Copper ....pounds..	2,118,452	264,804	1,254,153	195,648	− 864,299	− 69,156
Lead ....do....	64,312,559	2,813,674	45,280,817	2,128,198	−19,031,742	− 685,476
Zinc ....do....	....	....	1,972,327	116,367	+ 1,972,327	+ 116,367
Total...............	....	6,689,215	....	5,161,192	....	−1,528,023

Production of ore in Park City mining region, Utah, in 1904 and 1905.

	1904.		1905.		Decrease.	
	Short tons.	Value per ton.	Short tons.	Value per ton.	Short tons.	Value per ton.
Ore output.........................	250,047	$26.75	228,142	$22.62	21,905	$4.13

The gold and silver originated chiefly in the lead ores, and their production from this source for the last four years is as follows:

Production of gold and silver contained in lead ores in Uinta, or Park City district, Summit and Wasatch counties, Utah, in 1902, 1903, 1904, and 1905.

	1902.	1903.	1904.	1905.
Gold...................................fine ounces..	15,025	14,744	13,643	14,807
Silver...do....	7,967,296	6,835,908	5,814,386	3,998,165

Fourteen mines reported as contributors to the output in 1905. The same number reported in 1904. The principal producers named in order of importance are: Silver King Mining Company, Daly-West Mining Company, Kearns-Keith Mining Company, American Flag Mining Company, New York Bonanza Mining Company, Daly Mining Company, Moore Tailings Plant, Creole Mining Company, Jupiter Mining Company, Naildriver Mining Company, Odin Mining Company, and miscellaneous tailings plants on Silver Creek.

The development of the Silver King Mining Company property is by a vertical shaft 1,300 feet deep. It has been reported that this mine produced but little ore above the 700-foot level. From that level to the 1,110-foot level, nearly $25,000,000 worth of ore has been taken out. The richest ore on the 1,200-foot level contains as high as 60 per cent lead, 250 ounces silver, and nearly an ounce in gold. The mill, a 400-ton concentrator, handles the second-class ore from the mine.

The Daly-West Mining Company has reached 1,600 feet in depth by a vertical shaft to be continued to connect with the drain tunnel, which by agreement with the Ontario Silver Mining Company, is to be run under the Daly-West workings tapping the shaft at a depth of 2,100 feet. The shaft was discontinued on account of the caving of the great drain tunnel, and all the ore was thereafter handled through the 600-foot drain tunnel, loading the ore upon cars at their terminal. Ore bodies are blocked out below the 1,200-foot level, but can not be mined until the shaft and the great drain tunnel are completed. The mill operated two hundred and seventy-seven days and handled 110,792 dry tons, an average of four hundred tons per day. There were marketed 16,617 tons concentrates, and ore containing 9,521,000 pounds of lead and 868,460 ounces of silver. This property has produced since November, 1893, to December, 1905, a total of $10,189,969.78. It produced nearly one-fourth of this total sum in the year 1903. The average assay of the ore for the year 1902 and the average made for 1901 are shown as follows:

Average assays of Daly-West ore for 1901 and 1902.

	1901.					1902.				
	Silver.	Gold.	Lead.	Copper.	Zinc.	Silver.	Gold.	Lead.	Copper.	Zinc.
	Ounces.	*Ounces.*	*Per ct.*	*Per ct.*	*Per ct.*	*Ounces.*	*Ounces.*	*Per ct.*	*Per ct.*	*Per ct.*
Crude ore..........	61.15	0.05	23.28	2.45	17.7	52.66	0.041	19.40	1.90	9.40
Concentrates.......	46.68	.05	26.95	1.64	16.8	52.65	.040	28.71	1.67	16.50

The foregoing table shows that while the crude ore carried considerably higher values in all the metals in 1901 the concentrates did not run so high. The company is putting more tons of crude ore into the concentrates now, and is making a closer saving.

The Daly-Judge Mining Company, with property located in Summit and Wasatch counties, after nearly two years idleness, is to commence operations again. The mine is opened to a depth of 1,500 feet. Stoping has commenced on the 1,400-foot level. At the mill some new concentrating machinery has been added, and other changes have been made. The zinc middlings, which were previously a total loss, are now shipped to the plant of the Lanyon Zinc Company, near Salt Lake City.

The Ontario Silver Mining Company has its shaft down 2,000 feet. This is about 500 feet below the tunnel level. The company was unfortunate in losing its hoist at a time when the new Ontario mill was complete. When the hoisting plant was rebuilt the drain tunnel caved. Since then both mine and mill have been practically idle.

The property of the Kearns-Keith Mining Company adjoins the Silver King, and is owned by members of the Silver King Mining Company. Development is carried on by tunnels and inclines. This company is the consolidation of the Crescent, Apex, and Roos group. A mill of 150 tons daily capacity has been kept in operation during the year. About 75 men are employed in mine and mill.

The American Flag Mining Company owns property located east of Daly-Judge tunnel. The shaft is down 1,100 feet. Recently it installed a complete new hoisting and compressor plant.

The mine of the New York Bonanza Mining Company is developed by a shaft 400 feet deep. A winze was sunk from the 600-foot level 450 feet in depth, following ore most of the way down.

The Daly Mining Company is carrying on development work by tunnels, and occasionally shipping a little ore. The Creole Mining Company, besides developing the property, made several shipments taken out by lessees. The Jupiter, the Nail-driver, and the Odin companies each reported shipments, taken out while doing development work. A number of shipments were made from several jigging and table concentration plants, which treated old tailings on Silver Creek derived from the present and former reduction plants. The Little Bell Mining Company will be a producer in 1906. It developed and stored ore for shipment during the year, awaiting better wagon roads. The Silver King Consolidated Mining Company and the Comstock Company did considerable development work.

In Wasatch County a new mining district to be known as North Fork, located on the North Fork of the Duchesne River at an elevation of 7,300 feet, in the former Uinta Indian Reservation, was organized during 1905. A wagon road of easy grades and passable for the heaviest freight teams has been completed by the people of Woodland and Kamas from the former point into the district. Woodland is midway from the two railroad points—Park City and Heber—each about 40 miles distant. Ores of fair values have been found in limestone, but as yet are not sufficiently developed.

TOOELE COUNTY.

This county, from the discovery of mineral in 1863, has always been a producer of lead-silver ores. In 1890 it commenced to develop into a gold producer, the ores yielding readily to the cyanide process. When the decline in the output of lead-silver ores was greatest, the gold ore values kept the total values about even, until now one practically balances the other, with a prospect of the lead-silver ores again becoming important in 1906. The greatest developments have been in the Camp Floyd, Stockton, and Ophir districts.

In the Camp Floyd district development has been quietly going on, resulting in an increased production, which might have been greater had the Overland Mining Company not been compelled to close down in March owing to a serious caving of the incline shaft that caused the company to start an entirely new one.

In 1904 the mines at Stockton were unable to work below water level, as the volume of water was too great to make it profitable to mine and pump at the same time. Since then the Honorine drain and operating tunnel has been completed, and nearly all the older properties of the district have been drained to great depth. Consequently several properties have renewed production.

The Ophir district is not troubled with water, so that its output has been regular and is steadily increasing, with the result that it leads Stockton in value of its production for 1905.

The county is credited with an ore production in 1905 of 430,453 short tons, valued at $1,766,505, an average of $4.10 per ton. This is an increase of 34,203 tons in quantity and a decrease of $77,357 in value, as compared with the production of 396,250 short tons, valued at $1,843,862, an average per ton of $4.65, in 1904. The concentrates produced from three mills in the district amounted to 23,182 short tons, valued in gold at $76,732, or $3.31 per ton; in silver at $184,963, or $7.98 per ton. The bullion produced was all gold and amounted to 44,371 ounces, valued at $915,581, which represent the output of ores treated by the cyanide process. The ores treated by cyanide average about $3.95 per ton, and make up in tonnage about 81 per cent of the total output of the county. The balance is chiefly lead-copper ore, having its greatest value in silver. The production of gold, silver, and the other metals in Tooele County in 1904 and 1905 is as follows:

Production of gold, silver, and associated metals in Tooele County, Utah, in 1904 and 1905.

Metal.	1904.		1905.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold..........fine ounces..	36,757	$759,767	44,821	$926,532	+ 8,064	+$166,765
Silver..................do....	418,584	239,639	327,556	197,844	− 91,028	− 41,795
Copper ....pounds..	1,023,825	127,978	1,093,197	170,539	+ 69,372	+ 42,561
Lead ....do....	14,774,769	646,396	8,205,814	385,673	−6,568,955	− 260,723
Other metals..................	....	70,082	....	85,917	....	+ 15,835
Total.................	....	1,843,862	....	1,766,505	....	− 77,357

Production of ore in Tooele County, Utah, in 1904 and 1905.

	1904.		1905.		Increase.	Decrease (*per ton*).
	Short tons.	Value per ton.	Short tons.	Value per ton.		
					Short tons.	
Ore output	396,250	$4.65	430,453	$4.10	34,203	$0.55

The gold advanced mainly from the increased output of ores treated by the cyanide process; silver and lead decreased on account of the Honorine mine, devoting its main energy to the development of ore bodies and shipping of only such ore as was encountered in this work. Copper has only a slight increase over 1904 in quantity, but its value is considerably greater. Other metals, consisting of mercury and fluxing iron, show material increase.

The following table shows the source of gold and silver in 1904 and 1905, by kinds of ore:

Source of gold and silver in Tooele County, Utah, in 1904 and 1905, by kinds of ore.

[Fine ounces.]

Metal.	Year.	Siliceous ore.	Copper ore.	Lead ore.	Copper-lead-zinc ore.	Copper-lead ore.	Lead-zinc ore.	Total.
Gold	1904	36,292	....	86	168	212	....	36,758
	1905	44,292	2	127	176	1	223	44,821
Silver	1904	11,231	....	30,920	225,050	151,383	....	418,584
	1905	456	250	39,474	254,908	429	32,039	327,556

Fifteen mines reported as contributors to the output in 1905; the same number reported in 1904. The companies producing in 1905 were: Consolidated Mercur Gold Mines Company, Ophir Hill Consolidated Mining Company, Honorine Mining and Milling Company, Sacramento Gold Mining Company, Scranton Mining and Milling Company, Galena King Mining Company, Buckhorn Consolidated Mining and Milling Company, New Stockton Mining Company, Overland Gold Mining Company, Black Diamond Mining Company, Jay Bird Mine, Eureka Ophir Consolidated Mining Company, Cyclone Mining and Milling Company, Chloride Point Mining and Milling Company, and Queen of the Hills Mining Company.

Camp Floyd district.—The Consolidated Mercur Gold Mines Company has the distinction of being one of the first successfully using the cyanide process in the United States. The total quantity of gold produced by the Mercur camp since cyanide came into use aggregates 580,499 ounces; of this, fully 90 per cent was produced by this company, which has since paid $1,055,000 in dividends. This sum, added to the amounts paid out by the original Mercur and Golden Gate mines, brings the total up to $3,285,312.97. It continues a regular distributer of profits. The mine is developed by a shaft 500 feet deep and by tunnels, and forwards to the surface about 800 tons of ore, which is put through the mill daily, from which is extracted $2.97 per ton from $3.95 ore, the loss in tailings being measured by the difference of 98 cents. The gold production given in the published report for the last fiscal year was 35,251 fine ounces. About 400 men are employed. The Sacramento Gold Mining Company has developed its mine through a system of tunnels, shallow winzes, and raises. The mill is of 120-ton capacity and uses the cyanide process. The property, originnally worked for gold, is producing a large quantity of mercury each year. The Overland Gold Mining Company met with a disaster through the caving of the incline shaft in March, which caused the company to sink a new 60 degree incline shaft, started in August, which when completed will be 900 feet deep. A mill of 300 tons daily capacity, using the cyanide process, is connected with the mine.

North Tintic district.—The Scranton Mining and Milling Company is now developing into a lead and zinc producer due to the increased demand for the latter metal. Much lead ore was shipped during 1905, and zinc shipments will begin early in 1906 to Iola, Kans. Additional properties will be on the producing list for 1906.

Ophir district.—The Ophir Hill Consolidated Mining Company, the most important producer of the district, is developed by incline shafts. The concentration mill was enlarged during the year to handle 125 tons of ore per day. Part of the old tailing dump was reworked. The development of the Buckhorn Consolidated Mining and Milling Company consists of 3 tunnels, 200 feet vertically apart, on the same fissure, and crosscuts and drifts into 2 other fissures and a blanket vein, the whole amounting to more than 5,000 feet. The ore is essentially lead, with some copper. It carries about 1 ounce of silver to each per cent lead, and the lead varies from 20 to 65 per cent. The Jay Bird mine, another producer, is developed by tunnels and incline shafts, and has been making shipments regularly. The Eureka-Ophir, the Chloride Point, and the Queen of the Hills were also producers.

Rush Valley or Stockton district.—The Honorine Mining and Milling Company is developing the property by a tunnel which is in 8,988 feet from the portal. Most of the work performed was in connecting the old workings, and only the ore thus encountered was shipped. The large concentration mill was operated a short time during the year on old tailing dumps. As soon as the ore from the mine can be handled through the tunnel, the output of the district will be greatly augmented by this producer.

The development of the mine of the Galena King Mining Company is through a shaft which is intended to connect with the Honorine drain tunnel by crosscutting. Lead is the predominant metal. The production of the ore is curtailed until the tunnel is reached. The New Stockton Mining Company owns about 300 acres of mineral ground, which is being developed by a vertical shaft 880 feet deep. A large quantity of lead ore has been opened up, and regular shipments have been made by railroad, which is 1½ miles from the mine. A concentration mill at the mine treats 75 tons of ore per day. The Black Diamond Mining Company's property is developed by drifts, which run from the Honorine drain tunnel. Much of the lead ore taken out is produced in the regular course of development work. The mine of the Cyclone Mining and Milling Company is developed to 700 feet in depth. Several ore bodies have been disclosed, and regular shipments are assured.

The Deep Creek region is described under Juab County, as no producers were recorded on the Tooele County side of the district for 1905.

UINTA COUNTY.

Green River district.—Placer mining with rockers on the Green River, near the mouth of Cub Creek, was carried on in a small way by two operators. From last accounts a hydraulic plant was being erected by one of the operators.

UTAH COUNTY.

This county is covered by a small part of the Tintic mining district, whose greatest area lies in Juab County and is reported under that heading.

American Fork district.—The most important production reported was made by the Miller group of claims, from which lead ore of good grade was shipped.

WASHINGTON COUNTY.

Harrisburg district.—The mining camp of Silver Reef rose to prosperity rapidly and for eight years continued to produce from the sandstone formation large quantities of silver, the total output up to 1900 being estimated at $8,000,000. The silver occurred as black sulphurets, chlorides, and native silver in thin sheets, the best values occurring near the surface, but the largest bodies in the deeper workings. In 1883 a miners' strike caused most of the principal mines to shut down, and the decline in silver occurring soon after caused the camp to be abandoned. Now, only a few lessees are at work, and the output continues to be handled by the Brundage Mining and Reduction Company.

Tutsagubet district.—The Utah and Eastern Copper Company, operating the Dixie mine and smelter, made several shipments of copper matte during the year, until the mine and smelter closed down as the result of the caving of the 750-foot working shaft. This disaster cut off access to the ore bodies and made it necessary to drive a tunnel about 800 feet, which was completed by the end of the year and production resumed. The oxide and carbonate ores of copper contain some silver and average well in copper. The smelter is located at Shem, several miles below the mine. Acoma, Nev., on the San Pedro, Los Angeles and Salt Lake Railroad, is the shipping point. The copper property of the Paymaster Mining Company, in the same district, is being developed, and will probably become a producer during 1906.

WEBER COUNTY.

Sierra Madre district.—A small trial shipment was made by the Southern Pacific Mining Company during the year. Activity is stimulated by the building of a 400-ton copper smelter by the Utah Smelting Company, near Hot Springs, on the Oregon Short Line Railroad. This district extends into Box Elder County, where much development was being carried on at the close of 1905.

WASHINGTON.

By Charles G. Yale.

PRODUCTION.

The returns from the producers of the State of Washington for the calendar year 1905 show a yield of $405,078 in gold, $75,727 in silver, $16,958 in copper, and $28,437 in lead, a total for the year of $526,200. Compared with the previous year this is an increase of $8,172.

A material increase over 1904 is shown in the gold output; it amounts to $90,615 and is derived from five counties. King and Kittitas combined increased $9,655; Skamania and Snohomish, $14,074; and Stevens, $154,263. The other counties showed a lessened output of gold.

The silver product is less by $14,104 than in the previous year, due to the falling off of $24,268 in Stevens County, $1,016 in Whatcom County, and $978 in Franklin and Ferry counties. The counties of Asotin, Clark, Chelan, King, Kittitas, and Okanogan show nominal increases, while Skamania and Snohomish show a combined increase of $10,954. The total increase for the year of gold and silver combined was $76,511.

Of the 51 mines reporting production in the State 35 are deep mines and 16 placers. Of the total gold output of $405,078 only $6,439 came from the placers. The placer silver was nominal, virtually all of it coming from quartz operations, and the largest proportion from siliceous ores.

As to copper, the year's output was 108,709 pounds, valued at $16,958. Of this, $14,235 in value came from Skamania and Snohomish counties, $2,410 from Stevens County, and the rest from Kittitas County. The lead came from Stevens County, the total being 605,043 pounds, valued at $28,437, only a few hundred pounds being derived from Okanogan County.

The heaviest producer in quartz gold is Stevens County, with a year's record of $165,863. Kittitas is the largest placer producer, Skamania and Snohomish yield the most copper, and Stevens produces all the lead.

The county rank in gold production is as follows: Stevens, Ferry, Whatcom, Skamania and Snohomish, King and Kittitas, Chelan, Okanogan, Asotin, Clark, Franklin. In silver they rank as follows: Ferry, Skamania and Snohomish, Stevens, Whatcom, Okanogan, King and Kittitas, Chelan, Asotin; and in copper, Skamania and Snohomish, Stevens, King and Kittitas.

The fact that only 51 mines out of 670 in the entire State had any record of production shows that there is a lack of capital in Washington to carry on development work and to bring the mines to a productive stage. Reports were received from 619 mines which were held by assessment work, were patented, or were in process of development, but which made no production for the year. This is an exceptionally large proportion compared with the number of producers. Lack of cheap means of transportation to smelters is the principal reason assigned for so many idle properties. Most of the ores must be smelted at great distances from the principal districts. New railroads are projected, however, so that some of these difficulties will doubtless be overcome.

The following table shows in concrete form the comparative production of gold, silver, and associated metals for the last two years:

Production of gold, silver, and associated metals in Washington in 1904 and 1905.

	1904.		1905.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold............fine ounces..	15,212.13	$314,463	19,595.63	$405,078	+ 4,383.50	+$90,615
Silver ....do....	157,598	89,831	125,376	75,727	− 32,222	− 14,104
Copper ....pounds..	350,047	43,788	108,709	16,958	− 241,338	− 26,830
Lead ....do....	1,760,309	69,937	605,043	28,437	−1,155,266	− 41,500
Platinum.....crude ounces..	.5	9	....	....	− .5	− 9
Total..................	....	518,028	....	526,200	....	+ 8,172

To show the number of producing mines, the tonnage produced, and the quantity and value of gold, silver, copper, and lead the following table has been arranged by counties:

Production of gold, silver, copper, and lead in Washington in 1905, by counties.

County.	Producing mines.	Tonnage.	Gold.		Silver.	
			Quantity.	Value.	Quantity.	Value.
		Short tons.	*Fine ounces.*		*Fine ounces.*	
Asotin	3	....	49.58	$1,025	8	$5
Chelan	3	358	611.46	12,640	618	370
Clark	1	....	4.84	100	....	....
Ferry	4	9,540	4,162.81	86,053	34,945	21,107
Franklin	1	....	.92	19	....	....
King	1	1,000	902.53	18,657	868	524
Kittitas	11	67				
Okanogan	6	505	111.89	2,313	10,690	6,457
Skamania	1	14	1,955.56	40,425	29,946	18,087
Snohomish	7	5,150				
Stevens	10	12,016	8,023.62	165,863	26,195	15,822
Whatcom	3	18,000	3,772.42	77,983	22,111	13,355
Total	51	46,650	19,595.63	405,078	125,376	75,727

Production of gold, silver, copper, and lead in Washington in 1905, etc.—Continued.

County.	Copper.		Lead.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
Asotin					$1,030
Chelan					13,010
Clark					100
Ferry					107,160
Franklin					19
King, Kittitas	2,008	$313			19,494
Okanogan			200	9	8,779
Skamania, Snohomish	91,252	14,235			72,747
Stevens	15,449	2,410	604,843	28,428	212,523
Whatcom					91,338
Total	108,709	16,958	605,043	28,437	526,200

The increase or decrease in quantity and value of metals in 1905 as compared with the year 1904 are shown in the following table:

Increase (+) and decrease (−) in production of metals in Washington in 1905 as compared with 1904, by counties.

County.	Gold.		Silver.		Copper.		Lead.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*		*Pounds.*		*Pounds.*	
Asotin, Chelan and Clark	− 359.04	− $7,422	+ 621	+ $375				
Ferry and Franklin	−1,315.07	− 27,185	− 3,801	− 978	− 77,548	−$8,948		
King and Kittitas	+ 467.06	+ 9,655	+ 868	+ 524	+ 1,679	+ 267		
Okanogan	− 762.05	− 15,753	− 103	+ 305			+ 200	+ $9
Skamania and Snohomish	+ 680.83	+ 14,074	+17,432	+10,954	+ 13,402	+ 5,244		
Stevens	+7,462.47	+154,263	−44,138	−24,268	−178,871	−23,393	−1,155,466	−41,509
Whatcom	−1,790.70	− 37,017	− 3,101	− 1,016				
Total	+4,383.50	+ 90,615	−32,222	−14,104	−241,338	−26,830	−1,155,266	−41,500

The tons of ore sold or treated, the number of producing mines, and the average value per ton are shown as follows:

Tonnage of ore sold or treated, number of producing mines, and tenor of ores in Washington in 1904 and 1905, by counties.

[Short tons.]

County.	Total tons of ore sold or treated.		Number of deep mines producing.		Average total value per ton.		Average value per ton in gold and silver.	
	1905.	Increase (+) or decrease (−) compared with 1904.	1904.	1905.	1904.	1905.	1904.	1905.
	Short tons.	*Short tons.*						
Asotin, Chelan, and Clark...	358	− 2,642	2	3	$6.70	$36.34	$6.70	$36.34
Ferry and Franklin..........	9,540	−13,597	7	4	6.24	11.23	5.85	11.23
King and Kittitas............	1,067	+ 679	5	4	21.42	15.79	21.30	15.49
Okanogan....................	505	− 4,401	5	5	4.94	17.19	4.94	17.17
Skamania and Snohomish ..	5,164	+ 1,881	6	7	12.93	14.02	10.20	11.26
Stevens	12,016	+ 7,420	18	10	29.90	17.69	11.24	15.12
Whatcom	18,000	− 2,000	3	2	6.07	4.95	6.07	4.95
Total..................	46,650	−12,660	46	35	8.58	11.14	6.65	10.17

Tonnage and value of ore, concentrates, and old tailings in Washington in 1905, by counties.

[Short tons.]

County.	Total ore.		Concentrates produced.		Old tailings treated.	
	Quantity.	Value.	Qunatity.	Value.	Quantity.	Value.
Asotin, Chelan, and Clark	358	$13,010	....	....	208	$9,140
Ferry and Franklin..................	9,540	107,160	....	....	....	....
King and Kittitas....................	1,067	16,844	....	....	....	....
Okanogan	505	8,679	20	$1,200	....	....
Skamania and Snohomish..........	5,164	72,395	65	3,802	....	....
Stevens	12,016	212,523	....	....	....	....
Whatcom	18,000	89,114	200	20,000	....	....
Total..........................	46,650	519,725	285	25,002	208	9,140

Number of mines classified by chief product in Washington in 1905, by counties.

County.	Nonproducing mines.	Mines reporting production.	Gold placer mines.				Deep mines.				
			Hydraulic.	Drift.	Sluice.	Total.	Gold.	Silver.	Copper.	Lead.	Total.
Asotin	10	3			3	3					
Chelan	41	3					3				3
Clark	3	1			1	1					
Cowlitz	3										
Ferry	70	4					4				4
Franklin	1	1			1	1					
King	40	1					1				1
Kittitas	50	11	2	3	3	8	2		1		3
Lewis	2										
Lincoln	17										
Okanogan	131	6			1	1	3	2			5
Skagit	12										
Skamania	8	1							1		1
Snohomish	81	7			1	1	3		3		6
Stevens	104	10					4	4	1	1	10
Whatcom	45	3		1		1	1	1			2
Yakima	1										
Total	619	51	2	4	10	16	21	7	6	1	35

Source of gold production in Washington, by kinds of ore, in 1905, by counties.

[Fine ounces.]

County.	Placers.	Deep mines.				Total.
		Siliceous ores.	Copper ores.	Lead ores.	Total.	
Asotin, Chelan, and Clark	54.42	611.46			611.46	665.88
Ferry and Franklin	.92	4,162.81			4,162.81	4,163.73
King and Kittitas	127.32	775.21			775.21	902.53
Okanogan	4.84	107.05			107.05	111.89
Skamania and Snohomish	16.93	1,649.59	289.04		1,938.63	1,955.56
Stevens		8,022.50	1.12		8,023.62	8,023.62
Whatcom	107.05	3,665.37			3,665.37	3,772.42
Total	311.48	18,993.99	290.16		19,284.15	19,595.63
Increase (+) or decrease (−)	−163.70	+4,838.51	−291.31		+4,547.19	+4,383.45

Source of silver production in Washington, by kinds of ore, in 1905.

[Fine ounces.]

County.	Placers.	Deep mines.				Total.
		Siliceous ores.	Copper ores.	Lead ores.	Total.	
Asotin, Chelan, and Clarke	8	613			613	621
Ferry and Franklin		34,945			34,945	34,945
King and Kittitas	30	838			838	868
Okanogan		10,690			10,690	10,690
Skamania and Snohomish	4	25,790	4,152		29,942	29,946
Stevens		12,768	2,222	11,205	26,195	26,195
Whatcom	18	22,093			22,093	22,111
Total	60	107,737	6,374	11,205	125,316	125,376
Increase (+) or decrease (−)	+60	+16,019	−10,336	−37,965	−32,282	−32,222

It may be noted that all the data for the individual counties are contained in the preceding tables which give in detail the figures indicated in the respective headings.

REVIEW BY INDIVIDUAL COUNTIES.

ASOTIN AND CLARK COUNTIES.

There are only 4 producing mines in these two counties, all surface placers, showing a small gold output and a nominal output of silver. There are 13 known nonproducing claims.

CHELAN COUNTY.

In the Peshastin district in this county there are 3 productive quartz mines, worked on a small scale, having a combined milling capacity of 22 stamps. There is a decrease in the tonnage, but the value per ton of the ores worked is considerably higher than in 1904. A considerable portion of the total output of the year was derived from the working of old tailings. There are 41 nonproducing mines in the county.

FRANKLIN AND FERRY COUNTIES.

Franklin County has only 1 small placer mine in Pasco district in operation, with merely a nominal output.

In Ferry County there are 4 deep mines, all in Republic district, no placers having been worked.

Republic district.—Though somewhat less than 10,000 short tons of ore were worked from this district, the yield was $86,053 in gold and $21,107 in silver. The principal producers were the Ben Hur, Copper Key, Lone Pine, and Quilp. The output for the year shows a material decrease of both gold and silver, and the average value per ton is $11.23, as against $5.85 in 1904. There are 70 nonproductive mines in the county. No copper was produced in 1905, though over 75,000 pounds were obtained in 1904.

KING AND KITTITAS COUNTIES.

In King County is Money Creek district, with 1 productive deep mine; and in Kittitas are the Swauk and Fish Lake districts, with 11 producers, of which 8 are placer mines and 3 deep ones. The Apex Gold Mines is the productive company in Kings County, and the deep producers in Kittitas are the Helan Mining Syndicate and Gresh in Swauk district, and Gallagher Mining and Development Company in Fish Lake district. In placers the Cedar Valley Company is hydraulicking; the Emma, the Sunflower, and the Weniger are drifting, and the rest are recovering their gold by ground sluicing. They are working either bench gravel or ancient river beds. A little copper comes from Fish Lake district. Altogether in the two counties an increase of gold output of $9,655 in gold, and $524 in silver is shown. The average value per ton of the ore worked was $15.79 per ton, which is less than in the previous year. In King County there are 40 nonproducing mines, and in Kittitas there are 50.

OKANOGAN COUNTY.

This county shows a record of 131 nonproducing mines—the largest number in the State. It has 1 producing placer, the Ben Holland Placer Mining Company, and 5 deep mines—the Triune, owned by the Washington Consolidated Mining Company, the American Flag Mining Company, the Nighthawk mine, the Ruby Mining Company, and the Lakeview, owned by the Prize Mining Company. None are worked on a large scale, the combined output of gold and silver being small, and a marked decrease of gold output from the preceding year being evident.

SKAMANIA AND SNOHOMISH COUNTIES.

In these two counties are 8 productive mines, which, combined, show an increased output over 1904 of $14,074 gold, $10,954 silver, and $5,244 copper. The average value of the 5,164 tons of ore worked was $10.33 gold and silver, or in total value, including copper, $14.02, the averages being higher than in 1904. There is only one placer, with a nominal yield. The deep mines are the Sweden claim of the St. Helen Consolidated Mining Company in Skamania County, and in Snohomish County the Wayside Mining Company; Copper Bell of the Bunker Hill Mining and Milling Company, Justice Mining Company, Potomac Mining Company, and Peabody. The Monte Cristo district produced the largest proportion of the output. In the two counties there are 89 nonproductive mines.

STEVENS COUNTY.

This is the most productive mining county in Washington, the 10 active mines yielding in 1905 a total of $212,523, of which $165,863 was gold, $15,822 silver, $2,410 copper, and $28,428 lead. The increase in gold is $154,263, while the other metals show a falling off. This increase is mainly due to the operations of the First Thought Gold Mines at Orient, in Pierre Lake district, which is the largest gold producer in the State. Copper is produced by the Big Strike, owned by the Frisco Standard Mining Company of the Chewelah district; Copper King Mining Company, of the same district; Turk Mining Company, Deer Trail district, and Columbia River Gold Mining Company, of Kettle Falls district. The largest portion comes from the Copper King mines. The lead is derived mainly from the Jupiter Lead Company of Northport, the Young America Cliff Consolidated Mining Company at Bossburg, and the Frisco Standard Mining Company of Chewelah district, though some is produced by the Providence Mining Company of Deer Trail. The Jupiter Company's ore carries no gold or silver, and is shipped direct to Joplin, Mo. The largest part of the silver came from Chewelah district. Deer Trail is usually the largest silver producer, but few of the mines were running in 1905. Pierre Lake and Kettle Falls districts produced the largest portion of the gold.

WHATCOM COUNTY.

The 3 active mines of the county yielded $77,983 gold and $13,355 silver last year, but a falling off in yield is shown in both metals. The ore averages about $4.95 per ton. There are 45 nonproductive mines in the county. Of the active mines 2 are deep ones and the other a placer. The most productive quartz mine is the Mount Baker, in Mount Baker district, which mine made the heaviest output in the State in 1904, but was exceeded in 1905 by the First Thought Mining Company, of Stevens County.

WYOMING.

By Waldemar Lindgren.

PRODUCTION.

In 1905 Wyoming producers reported gold to the value of $26,745, an increase over 1904 of $9,440.

The insignificant production of silver amounted to only 3,655 fine ounces, a decrease of 992 ounces compared with 1904.

The silver and gold was derived from 7 placer mines and 6 deep mines. The latter yielded 31,007 tons of ore, with an average value per ton in gold and silver of $0.87.

Production of gold, silver, and copper in Wyoming in 1904 and 1905.

	1904.		1905.		Increase (+) or decrease (−) in 1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.................fine ounces..	837.13	$17,305	1,293.81	$26,745	+ 456.68	+$9,440
Silver.......................do....	4,647	2,661	3,655	2,208	− 992	− 453
Copper..................pounds..	3,527,008	440,876	2,394,008	373,465	−1,133,000	−67,411
Total..........................	....	460,842	....	402,418	....	−58,424

The small production of gold and silver in Wyoming has often been commented on as remarkable in contrast to the conditions in Colorado, its southern neighbor. Probably geological conditions are responsible for this anomaly. Wyoming possesses many imposing mountain ranges, such as the Medicine Bow and Sierra Madre in the south, and the Big Horn and Wind River ranges in the north. But these consist almost exclusively of pre-Cambrian granites and schists. The Cretaceous and Tertiary intrusive rocks which are responsible for the rich mineralization of the Colorado deposit are generally absent in Wyoming. Most of the deposits appear to be of pre-Cambrian age, and consist partly of pyritic copper ores, containing some gold and silver, and frequently enriched in the upper levels, partly of gold-quartz veins of the Appalachian type. The former are exemplified in the copper deposits of Carbon and Albany counties; the latter in the gold deposits of Fremont County.

The output of copper was less in 1905 than in 1904, but it is believed that the industry will develop to considerable importance by the treatment of low-grade ores. The output of gold was chiefly derived from Fremont County, and this, too, it is thought, is capable of further extension. The State contains large areas of little prospected lands in Fremont and Big Horn counties, in which, as transportation facilities increase, producing mines may be expected to be developed.

Production of gold, silver, and copper in Wyoming in 1905, by counties.

County.	Producing mines.	Gold.		Silver.		Copper.		Total value.
		Quantity.	Value.	Quantity	Value.	Quantity.	Value.	
		Fine ounces.		*Fine ounces.*		*Pounds.*		
Albany, Carbon, and Natrona.	4	238.32	$4,926	3,559	$2,150	2,394,008	$373,465	$380,541
Crook..................	3	62.26	1,287	10	6	....	....	1,293
Fremont and Uinta.	6	993.23	20,532	86	52	....	....	20,584
Total..........	13	1,293.81	26,745	3,655	2,208	2,394,008	373,465	402,418

Increase (+) and decrease (−) in production of metals in Wyoming in 1905 as compared with 1904, by counties.

County.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*		*Pounds.*	
Albany, Carbon, and Natrona......	− 88.02	−$1,820	−1,044	−$486	−1,133,000	−$67,411
Crook..............................	− 57.76	− 1,194	− 34	− 19	....	....
Fremont and Uinta..................	+602.46	+12,454	+ 86	+ 52	....	....
Total..............................	+456.68	+ 9,440	− 992	− 453	−1,133,000	− 67,411

Tonnage of ore sold or treated, number of deep mines producing, and tenor of ores in Wyoming in 1904 and 1905, by counties.

County.	Total tons of ore sold or treated.		Number of mines producing.		Average total value per ton.		Average value per ton in gold and silver.	
	1905.	Increase (+) or decrease (−).	1904.	1905.	1904.	1905.	1904.	1905.
	Short tons.	*Short tons.*						
Albany, Carbon, and Natrona...	28,126	−13,264	4	3	....	$13.53	$0.23	$0.25
Crook, Fremont, and Uinta	2,881	+ 2,177	4	3	....	6.86	11.87	6.86
Total....................	31,007	−11,087	8	6	....	12.91	.42	.87

Number of mines classified by chief product in Wyoming in 1905, by counties.

County.	Mines reporting production.	Gold placer mines.			Deep mines.		
		Surface placers.	Drift mines.	Total.	Silver.	Copper.	Total.
Albany....................	2	1	....	1	....	1	1
Carbon....................	1	....	....	....	....	1	1
Crook.....................	3	2	1	3	....	....	....
Fremont...................	5	2	....	2	3	....	3
Natrona...................	1	....	....	....	....	1	1
Uinta.....................	1	1	....	1	....	....	....
Total.....................	13	6	1	7	3	3	6

Source of gold and silver production in Wyoming in 1905, by kinds of ore.

[Fine ounces.]

	Placers.	Deep mines.			Total.
		Siliceous ores.	Copper ores.	Total.	
Gold....................	102.38	961.11	230.32	1,191.43	1,293.81
Increase (+) or decrease (−)	5.54	+558.24	− 96.02	+ 462.22	+ 456.68
Silver....................	10	86	3,559	3,645	3,655
Increase (+) or decrease (−)	+ 10	+ 42	−1,044	−1,002	− 992

REVIEW BY INDIVIDUAL COUNTIES.

ALBANY COUNTY.

The production of Albany County in 1905 was not large. The principal operations were carried on in the southwestern corner of the county on the eastern slope of the Medicine Bow Range. In the Douglas Creek district the Cuperite mine, operated by the Medicine Bow Mining Company, produced some gold and silver bearing copper ore. The American Copper Company is opening their property by a 350-foot shaft, and the Rambler Mining and Smelting Company has about 1,000 feet of development work. The latter property is equipped with a 50-ton smelter. Placer operations on a small scale are also carried on in the same district. The gold produced is exceptionally fine, ranging from 910 to 950. Only development work is reported from the Keystone, Jelm Mountain, La Plata, and Centennial districts.

Copper and silver prospects are found at many places in the Black Hills of Laramie along the eastern boundary line of Albany County in granites and schists of pre-Cambrian age like those of the Medicine Bow Range. Copper prospects are found in Tie Siding, Granite, Spring Hill, and Fish Creek districts. In the Granite district, northeast of Laramie, the Strong Copper Mining Company has a 300-foot shaft, and states that it is preparing to erect a concentrator.

BIGHORN COUNTY.

No production was reported from Bighorn County, but considerable prospecting was done in the mountains. Placers are found on Charles Fork in the extreme northwestern corner of the county near the Montana line.

In the Sunlight district, also in the northwestern corner of the county, the Sunlight Mining Company is developing a property carrying pyrite and chalcopyrite with gold and silver.

In the Wood River district, near Kirwin, many properties were prospected, among them those of the Galena Ridge Mining Company, which are opened by a tunnel 1,250 feet in length.

Little is known of the geology of these deposits, but they probably all occur in pre-Cambrian rocks. Lack of transportation facilities interferes with the development of these districts.

CARBON COUNTY.

The principal metal-producing region in Carbon County is near Encampment, in the southern part of the county, not far from the Colorado line. The rugged Sierra Madre, forming the northward extension of the Park Range of Colorado, here culminates in Bridger Peak, with an elevation of 11,007 feet. The mines in this important copper district were located about 1898, and center about the post-offices of Rudefeha, Dillon, Copperton, Rambler, and Battle. This vicinity is usually referred to as the Battle Lake mining district, and has been described by Mr. A. C. Spencer in Professional Paper No. 25, United States Geological Survey.[a] The principal mines are the Haggarty and the Rambler, both of which are now controlled by the Penn-Wyoming Copper Company.

The ore consists of a mixture of gold and silver bearing chalcopyrite, pyrite, and chalcocite. The latter constituent, a product of secondary sulphide enrichment, diminishes as depth is attained. The Rambler and the Haggarty mines are both working on copper sulphides occurring in brecciated masses of pre-Cambrian quartzite, and the deposits are probably of pre-Cambrian age.

Only development work was done on the Rambler at a depth of 600 feet, where it is said a large body of low-grade copper ore has been opened. The principal production of the county came from the Haggarty mine. The ore is carried from the mine to the concentrator and smelter at Encampment over a 16-mile long tramway, and the capacity of the works is estimated at 500 tons of ore per day. The smelter is equipped with two furnaces and convertors designed for an output of about 15 tons of bessemer copper per day.

The Encampment smelter was only operated from June to December.

There are a great number of smaller mines in the district, most of which are only doing development work. Among them are the Itmay, Hinton, Charter Oak, Hidden Treasure, Independence or Leighton-Gentry, Dill, and Anchoria. It is expected that railroads will be built into the district from the north and from the south during 1906 or 1907.

Southwest of the Battle Lake district near Slater and the Colorado line several companies are prospecting lead-silver properties.

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[a] Spencer, A. C., The copper deposits of the Encampment district, Wyoming: Prof. Paper U. S. Geol. Survey No. 25, 1904.

CONVERSE COUNTY.

A number of copper prospects are found in the southern part of Converse County and the adjoining part of Laramie County. In the Wild Cat and several other districts development work has been carried on. These deposits are probably similar to those found at intervals southward in the Black Hills of Laramie, and occur in pre-Cambrian granite rocks.

CROOK COUNTY.

A small placer output is maintained from Crook County, which is situated in the extreme northeastern corner of Wyoming adjacent to the Black Hills of South Dakota.

FREMONT COUNTY.

The principal output of gold in Wyoming is obtained from the Atlantic City and South Pass district in the southern end of the Wind River Range. The deposits are reported to occur in pre-Cambrian schists and granites, and present much similarity to the gold-bearing veins of the southern Appalachian States. Placers are operated on a small scale, and several quartz mines are being worked. Among the latter are the Carissa mine of the Federal Gold Mining Company, the Garfield of the Travelers Gold Mining Company, and the properties of the Dexter Mining and Development Company. A number of placers and lode claims are also located at Lewiston, 12 miles southeast of Atlantic City. The district is very isolated, the distance from the Union Pacific Railroad at Rawlins being 125 miles.

LARAMIE COUNTY.

The low granite and schist range of the Black Hills of Laramie follows the western boundary line of this county, and contains at intervals deposits of copper, gold, and silver, all of which are as yet in the stage of prospects. No production was reported in 1905. The best known district is the Silver Crown, 20 miles east of Cheyenne.

NATRONA COUNTY.

A new copper district has been prospected in the mountains south of Casper. Some copper ore was shipped to Denver smelters from the Blue Cap mine in this district.

UINTA COUNTY.

A little placer gold is reported from Jackson Hole, near the western boundary line of the State.

COPPER.

By Charles Kirchhoff.

GENERAL TRADE CONDITIONS.

The year 1905 has been one of extraordinary prosperity for the American copper trade. It has witnessed a production exceeding 901,000,000 pounds, an enormous home consumption, prices which have been very remunerative, and an export trade which was nearly up to the record. It must be noted, however, that there would have been a serious falling off in shipments abroad had it not been for the fact that China took nearly 80,000,000 pounds, as compared with 10,000,000 pounds in 1904, when the movement first began.

A glance at the figures showing the production of the different States and Territories reveals the fact that each of the three great districts participated largely in the growth. In the Lake Superior district the Calumet and Hecla and the Champion group are chiefly responsible. In Montana the North Butte Company chiefly deserves credit for the increase in the State. In Arizona the Old Dominion and the Copper Queen made the largest additions. In Utah nearly every one of the leading producers increased its output. The decline in California and in Tennessee was due to temporary local conditions. Both will more than recover in 1906. Alaska will show an increase this year, and Nevada will in 1907 begin to be an important factor.

With the increased activity of old producers in nearly every district, with peace in Montana, and the certainty of profitable ores in depth in the Butte district, with the increased facilities for handling enormous bodies of low-grade ore in Utah, Tennessee, Nevada, California, and elsewhere, a very large increase in the production is certain for 1906 and particularly for 1907. In the report for 1904 the belief was expressed that 1905 would possibly witness a production of 900,000,000 pounds. That figure was exceeded. It seems likely that the record of 1906 will show a further addition of at least 70,000,000 pounds to the output of the United States.

PRODUCTION.

UNITED STATES.

The following tables show the production of copper in the United States since work on this metal has risen 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.	Year.	Total production.	Lake Superior.	Percentage of Lake Superior of total production.
1845	100	12	12	1864	8,000	5,576	69.7
1846	150	26	17.3	1865	8,500	6,410	75.4
1847	300	213	71	1866	8,900	6,138	69
1848	500	461	92.2	1867	10,000	7,824	78.2
1849	700	672	96	1868	11,600	9,346	80.6
1850	650	572	88	1869	12,500	11,886	95.1
1851	900	779	86.6	1870	12,600	10,992	87.2
1852	1,100	792	72	1871	13,000	11,942	91.9
1853	2,000	1,297	64.9	1872	12,500	10,961	87.7
1854	2,250	1,819	80.8	1873	15,500	13,433	86.7
1855	3,000	2,593	86.4	1874	17,500	15,327	87.6
1856	4,000	3,666	91.7	1875	18,000	16,089	89.4
1857	4,800	4,255	88.6	1876	19,000	17,085	89.9
1858	5,500	4,088	74.3	1877	21,000	17,422	83
1859	6,300	3,985	63.3	1878	21,500	17,719	82.4
1860	7,200	5,388	74.8	1879	23,000	19,129	83.2
1861	7,500	6,713	89.5	1880	27,000	22,204	82.2
1862	9,000	6,065	67.4	1881	32,000	24,363	76.1
1863	8,500	5,797	68.2	1882	40,467	25,439	62.9

Production of copper in the United States, 1883–1905, 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
1905	402,637	102,807	25.5	140,514	34.9	105,637	26.2

Previous volumes of Mineral Resources contain a detailed statement of the copper production of the United States, territorially, from 1883, when the statistics were first collected by this office, to 1893. Since then the production has been as follows:

Total copper production in the United States, 1893–1905.

[Pounds.]

Source.	1893.	1894.	1895.	1896.	1897.	1898.
Lake Superior	112,605,078	114,308,870	129,330,749	143,524,069	145,282,059	158,491,703
Arizona	43,902,824	44,514,894	47,953,553	72,934,927	81,530,735	111,158,246
Montana	155,209,133	183,072,756	190,172,150	221,918,179	230,288,141	206,173,157
New Mexico	280,742	31,884	143,719	2,701,664	701,892	1,592,371
California	239,682	120,000	218,332	690,237	11,987,772	16,925,634
Utah	1,135,330	1,147,570	2,184,708	3,502,012	3,919,010	3,750,000
Colorado, including copper smelters[a]	7,695,826	6,481,413	6,079,243	6,022,176	11,873,033	16,274,561
Wyoming	....	....	....	....	....	233,044
Nevada	20,000	....	....	....	....	437,396
Idaho	36,367	....	1,425,914	....	183,277	1,266,920
South Dakota	....	....	....	....	2,440,338	1,261,393
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	5,395,226
Lead desilverizers, etc.[b]	7,456,838	2,136,473	....	4,063,173	1,400,000	3,553,336
Total domestic copper	329,354,398	354,188,374	380,613,404	460,061,430	494,078,274	526,512,987

Source.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
Lake Superior	147,400,338	145,461,498	156,289,481	170,609,228	192,400,577	208,309,130	230,287,992
Arizona	133,054,860	118,317,764	130,778,611	119,944,944	147,648,271	191,602,958	235,908,150
Montana	225,126,855	270,738,489	229,870,415	288,903,820	272,555,854	298,314,804	314,750,582
New Mexico	3,935,441	4,169,400	9,629,884	6,614,961	7,300,832	5,368,666	5,334,192
California	26,221,897	28,511,225	33,667,456	25,038,724	17,776,756	28,529,023	16,697,489
Utah	9,584,746	18,354,726	20,116,979	23,939,901	38,302,602	47,062,889	58,153,393
Colorado, including copper smelters[a]	11,643,608	7,826,949	9,801,783	8,422,030	4,158,368	9,506,944	9,404,830
Alaska	....	....	....	....	1,339,590	2,043,586	4,900,866
Wyoming	3,104,827	4,203,776	2,698,712	889,228	1,023,189	3,565,629	2,530,531
Nevada	556,775	407,535	593,608	164,301	150,000	....	413,292
Idaho	110,000	290,162	480,511	227,500	778,906	2,158,858	7,321,585
South Dakota	17,020	15,147	753,510	445,663	173,202	100,000	38
Washington	....	....	....	209,297	80,758	663,694	223,328
Oregon	....	....	....	....	....	....	846,615
Maine and New Hampshire; Vermont; Tennessee and Southern States; Middle States	4,410,554	4,820,495	6,860,039	13,599,047	13,855,612	15,211,086	15,134,960
Lead desilverizers, etc.[c]	3,500,000	3,000,000	531,530	500,000	500,000	100,000	....
Total domestic copper	568,666,921	606,117,166	602,072,519	659,508,644	698,044,517	812,537,267	901,907,843

[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] Since 1901 the quantity stated covers only that part of the incidental copper product the source of which could not be ascertained.

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, 1899–1905.

[Pounds.]

Mine.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
Tamarack	18,565,602	19,181,605	18,000,852	15,961,528	15,286,093	14,961,885	15,824,008
Quincy	14,301,182	14,116,551	20,540,720	18,988,691	18,498,288	18,343,160	18,827,557
Osceola	11,358,049	12,567,131	13,723,487	13,416,396	16,059,636	20,472,429	18,938,965
Franklin	1,230,000	3,663,710	3,757,419	5,259,140	5,309,030	4,771,050	4,206,085
Atlantic	4,675,882	4,930,149	4,666,889	4,949,366	5,505,598	5,321,859	4,049,731
Wolverine	4,756,646	4,778,829	4,946,126	6,473,181	9,024,034	9,764,655	9,464,418
Baltic	621,336	1,735,060	2,641,432	6,285,819	10,580,997	12,177,729	14,384,684
Champion				4,165,784	10,564,147	12,212,954	15,707,426
Trimountain				5,730,807	9,237,051	10,211,230	10,478,462
Isle Royale			2,171,955	3,569,748	3,134,601	2,442,905	2,973,761
Mohawk			677,145	908,479	6,284,327	8,149,515	9,378,614
Mass	42,800	122,239	873,297	2,345,805	2,576,447	2,182,931	2,007,950
Michigan				166,898	275,708	2,739,122	2,891,796
Winona				101,188	1,036,944	646,025	
Phoenix			93,643		202,823	1,162,201	273,219
Adventure			29,361	606,211	2,182,608	1,380,480	1,606,208
Ahmeek						376,687	1,552,957
Centennial			806,400			641,294	1,446,584
Allouez							1,167,957

There has been great activity not alone in the working of established producers in the Lake Superior district, but also in the resumption of work in old mines and in the exploration and development of hitherto virgin ground. Among these prospective new producers are the Keweenaw Copper Company, which is drilling on the Mandan-Medora property; the old Delaware; the old Cliff, owned by the Tamarack Mining Company; the Old Colony and the Mayflower; the Superior, on the Baltic lode, acquired by interests connected with the Calumet and Hecla Company; the Tecumseh and the Rhode Island, which are opening the Kearsarge amygdaloid; the Globe, south of the Champion; the King William, south of the Winona and the Challenge; the Erie-Ontario; the Elm River; the Lake Copper Company, which is exploring the old Belt property; and the Copper Crown, which is exploring the old Norwich.

Calumet and Hecla.—A record production characterized the operations of the Calumet and Hecla Company, which probably will reach an output of over 100,000,000 pounds during the current year. The remodeling of the stamp mill is approaching completion. The company is now mining regularly in its Osceola branch and is also developing the Kearsarge amygdaloid.

Quincy.—The yield of the Quincy rock stamped declined still further in 1905, having been 16.6 pounds of fine copper per ton, as compared with 18 pounds in 1904, 19.3 pounds in 1903, and 23.2 pounds in 1901. The quantity stamped in 1905 was 1,135,162 tons, which produced 18,827,557 pounds of ingot copper, as compared with 18,343,160 pounds in 1904, a gain of nearly 500,000 pounds. The sales of copper yielded $2,981,121, an average of 15.83 cents, and interest and real estate added $29,286. The mining expenses were $1,715,419, taxes in Michigan $51,406, smelting and freight $139,098, and construction $138,733, thus leaving a net profit of $965,751, out of which dividends aggregating $600,000 were paid.

Tamarack.—The Tamarack Mining Company handled a larger quantity of rock and made a larger product of copper in 1905, although the average yield was smaller than in 1904. There were stamped 750,120 tons of rock, which yielded 15,824,008 pounds of refined copper, an average of 21.1 pounds per ton, as compared with 23.3 pounds in 1904. The cost of mining and stamping per ton of rock showed a decline from $2.46 in 1904 to $2.39 in 1905, but on account of the lower yield the cost per pound of copper was larger, as is shown in the following comparison:

Comparative cost of copper at Tamarack mine in 1904 and 1905.

[Cents per pound.]

	1904.	1905.
Mine costs	10.54	11.31
Construction	1.08	.55
Smelting, freight, selling, etc	1.36	1.51
Total	12.98	13.37

The copper, having been sold at an average of 15.47 cents per pound, yielded $2,448,239.57. The running expenses were $2,029,118.71, leaving a gross profit of $419,120.86. The construction expenses were $86,413.62, so that the net profit for the year was $332,707.24. Two dividends, aggregating $300,000, were paid. The company has begun mining on the Osceola amygdaloid in the levels tributary to No. 1 shaft, at which the Conglomerate lode was worked out some years ago. The development on the Conglomerate in the territory of No. 2 shaft has been practically completed, and sufficient ground is blocked out of a fair quality to keep the hoists at this shaft busy for years. The Osceola amygdaloid is being opened up in this territory. The North Tamarack, or No. 3 shaft, had reached a depth of 5,139 feet on January 1, it being the deepest vertical shaft in the world. The area of good copper ground on the Conglomerate is spreading. At the mill one of the seven stamps has been compounded. Four more stamps will be similarly changed and equipped with recrushing rolls, and it is expected that the five compound heads will stamp the same quantity of rock as the seven simple ones, at a considerably lower cost.

Osceola.—Owing to loss of time brought about by a strike, the output of the Osceola was considerably less in 1905 than it was in 1904, it having been 20,472,429 pounds in the latter year and 18,938,965 pounds in 1905. The quantity of rock stamped was 1,007,200 tons, and the yield of copper per ton of rock stamped was 18.8 pounds. The cost of mining per ton of ore stamped was $1.39 in 1905, as compared with $1.32 in 1904, and the cost of stamping was 17 and 18 cents, respectively. The total cost per pound of copper was 10.68 cents in 1905, as compared with 9.96 cents in 1904. The copper was sold at an average price of 15.54 cents per pound, or $2,942,239, and other income carried the receipts up to $2,961,371. The outlays for mining and stamping were $1,575,691, for smelting and freight $239,429, and for construction $207,505, leaving a profit of $938,746. Dividends aggregating $576,900 were paid.

The Osceola branch continues to show improvement, while the North Kearsarge has not been doing so well. The entire mill has been remodeled, and now has 6 compound stamps and recrushing rolls, the improvements having increased the capacity of the mill by 25,000 tons per month.

Atlantic.—As the result of a change in the method of mining the tonnage of the Atlantic mine declined from 390,526 tons in 1904 to 295,220 tons in 1905, and the production of the fine copper fell from 5,321,859 pounds to 4,049,731 pounds. The workings in the extreme northern and southern portions of the property have been abandoned, the central portion being more productive. The company sold its copper for $642,305.80, an average of 15.86 cents per pound. The working expenses of the mine were $512,025.13, and the smelting, freight, and other expenses footed up to $50,321.94, leaving a mining profit of $79,958.73. There was expended for construction and exploration the sum of $15,095.92, and there remained a net gain for the year of $64,862.81.

Copper Range Consolidated.—The net income of the Copper Range Consolidated Company, which controls the Baltic and Trimountain mines, one-half of the Champion mine, and the Copper Range Railroad, was $2,517,686. After paying a dividend for 1905 of $1,536,086, after deducting all construction charges of the mines, railroad, and smelting works, and after expending $54,534 for the development of the Globe property, there was a surplus fund from operations of $647,418. These results were obtained at an average price of copper of 15.56 cents, the production of the three mines having been 40,568,572 pounds in 1905, as compared with 34,601,913 pounds in 1904.

The Baltic mine stamped in 1905 604,709 tons of rock, which yielded 14,384,684 pounds of copper, or at the rate of 22.74 pounds per ton. The cost per ton of rock was $1.57 and, inclusive of construction, $1.99. The copper sold at an average of 15.76 cents and yielded gross receipts of $2,266,416, while operating expenses footed up to $1,087,842, taxes and interest to $43,856, and construction to $75,552, leaving a net profit of $1,059,166. The stamps at the mill have been compounded, and the plant now has a capacity of 2,500 tons per day. No. 2 shaft is being developed and equipped.

The Trimountain handled a larger amount of rock, stamping 570,842 tons in 1905, as compared with 534,640 tons in 1904. The product was not correspondingly larger, being 10,478,462 pounds as compared with 10,211,230, because the grade fell off from 19.1 pounds per ton in 1904 to 18.36 pounds in 1905. The cost per ton of rock was $1.59 in 1905 against $1.89 in 1904. The gross receipts were $1,620,893, the average price for copper having been 15.47 cents. The operating expenses were $1,048,701, taxes and interest $52,264, and construction $44,225, leaving a net profit of $475,703.

The Champion mine has shown the most rapid progress, having treated, in 1905, 604,483 tons of rock, against 442,061 tons in 1904, and 389,082 tons in 1903. The production of copper increased from 12,212,954 pounds in 1904 to 15,707,426 pounds in 1905, the yield having fallen, however, from 27.63 pounds per ton of rock in 1904 to 25.98 pounds in 1905. The copper, selling at an average price of 15.56 cents, realized $2,444,554.

The cost per ton of rock fell from $2.12 in 1904 to $1.65 in 1905, exclusive of construction outlays. The total operating expenses were $1,205,221, taxes and interest amounted to $115,364, and construction to $147,177. This left a net profit of $976,792.

The Globe property immediately to the south of the Champion mine is being opened up by the Copper Range Company. A shaft is being sunk, which it is expected will reach the lode at a depth of 250 feet before the end of 1906. If it proves as rich as anticipated a company owned entirely by the Copper Range Consolidated will be organized, which shall be called the John Stanton Mining Company.

Franklin.—The production of the Franklin mine fell off from 4,771,050 pounds in 1904 to 4,206,085 pounds in 1905, chiefly owing to five weeks' strike at the mine and to the falling off of the old Franklin mine. The Franklin Junior had not during the year opened the rich shoot showing in the bottom of No. 1 shaft. The total receipts were $745,204, including $82,281 from copper carried over from the preceding year. The expenses were $668,076, leaving a surplus of $77,128. The company is exploring for the Kearsarge and Pewabic lodes.

Isle Royale.—An increased output obtained at a lower cost characterized the operations of the Isle Royale mine during 1905. The quantity of rock stamped was 195,150 tons, as compared with 154,830 tons in 1904, the product of fine copper being 2,973,761 pounds and 2,442,905 pounds, respectively. The costs compare as follows:

Cost of production of copper at mine Isle Royale in 1904 and 1905.

[Cents per pound.]

	1904.	1905.
Cost at mine	9.62	9.19
Cost for construction	.20	.34
Cost for smelting, freight, etc	2.20	2.05
	12.02	11.58
Cost for explorations, etc	1.28	1.18
Total	13.30	12.76

The copper product was sold at $461,686.69, an average of 15.53 cents per pound, and interest, etc., carried the total receipts up to $477,399.94. The net profit for the year was $97,986.95. The company has continued exploration in section 11 and on the Baltic lode.

Mohawk.—The Mohawk closed its third year of active producing operations on the Kearsarge lode with the year 1905 and brought its product up to 9,387,614 pounds, as compared with 8,149,515 pounds in 1904 and 6,284,327 pounds in 1903. There were stamped 586,305 tons of rock out of 659,291 tons hoisted, the yield being 16.01 pounds of copper per ton of rock, against 17.75 pounds in 1904 and 21.79 pounds in 1903. The cost of production per ton of rock stamped was $1.384. This is made up of 49.2 cents for mining, 22.9 cents for timbering, tramming, and labor, 4.6 cents for hoisting and pumping, 6.9 cents for power drills, 5.3 cents for supplies and electric light, a total underground cost of 88.9 cents. To this must be added 8.6 cents for surface expenses less rents, 6.8 cents for rock-house expense, 13.6 cents for transportation, and 20.5 cents for stamping. This figures 8.65 cents per pound of copper for mining and stamping. To this must be added 1.12 cents per pound for smelting, freight, and marketing, and 1.14 cents for construction, which carries the total to 10.91 cents cost per pound of copper. In 1904 it was 11.39 cents and in 1903, 11.02 cents. The copper was sold at an average of 15.53 cents. The total income was $1,460,586, and the net profit for the year was $412,173, out of which a dividend of $200,000 was paid. A fourth stamp is to be added to the mill, and the simple stamps are to be compounded, improvements which are expected to carry the output to about 15,000,000 pounds per annum.

Michigan.—The annual report of the Michigan shows a production of copper of 2,891,796 pounds, which sold for an average of 15.69 cents per pound, or $453,683. The expenses amounted to $458,453, including $362,277 at the mine, $30,062 for smelting and freight, and $66,114 for other purposes.

Mass.—The Mass Consolidated Mining Company continued development work actively during the year and will probably be in shape by September to supply the mill with 1,000 tons of rock per day. Accordingly the company has advised the Michigan Copper Company that the stamp now leased to that company at 40 cents per ton will be required. During 1905 the Mass has operated one of the stamps, crushing 143,430 tons, which yielded 1,876,320 pounds of mineral. In addition to this the mine produced 885,170 pounds of mass copper and obtained 2,007,950 pounds of refined copper. This was sold at an average price of 16.433 cents per pound.

Allouez.—The Allouez Company has been very rapidly opening up the Kearsarge lode through two shafts. With one of the Centennial stamps used half time from August 1, 1905, to January 1, 1906, there were crushed 41,120 tons, which yielded 1,167,957 pounds, or 1.42 per cent, thus showing the richness of the ground. The copper sold at an average of 16.671 cents. After deducting all expenses, including cost of construction and equipment, the profit was $19,143. The company has now the use of one stamp and has considerably increased its product.

Adventure.—The Adventure, which is working chiefly on the Knowlton lode, produced 1,606,208 pounds of copper which was sold at an average of 15.72 cents per pound, yielding $252,572. The cost of mining, smelting, and construction amounted to $341,223, thus showing a loss of $88,651. During the year $50,000 was paid in as an installment on the stock.

Centennial.—The Centennial Mining Company is actively engaged in developing on its property the copper shoot of the Kearsarge lode, which has been so productive in the Wolverine and South Kearsarge mines. During the year 1905 the company had the use of one stamp head half the time, but will have one stamp full time after January 1, 1906. By closer selection of the stamp rock the product was increased during 1905, the yield from crushing 84,890 tons having been 1,446,584 pounds, as compared with 641,294 pounds in 1904. The copper was sold at an average of 15.91 cents. The receipts, which footed up to $680,062, included $353,892 from assessments, while the payments aggregated $348,281, including $257,622 for mining expenses, $42,762 for smelting and marketing, and $47,897 for construction and equipment.

Wolverine.—The annual report of the Wolverine Copper Company covers the year ending June 30, 1905. During that period the company sold 9,729,971 pounds of copper at 13.83 cents average, or for $1,345,402. Interest carried the total receipts to $1,351,880. The working expenses at the mine were $496,062, and the cost for freight and smelting were $109,373, leaving a mining profit of $746,445. Construction called for only $5,111. The dividends declared amounted to $540,000.

Victoria.—The Victoria Mining Company will be added to the ranks of Lake Superior producers in 1906. Development work has reached the point where five years' supply of rock is blocked out, a compressor plant has been installed, and the stamping mills nearing completion.

MONTANA.

A year of full work at all of the mines and the entry of the North Butte mine into the ranks of large producers brought out a very large output of copper in the Butte district. It is sure to show a further material increase, because a number of mines which were tied up by litigation are now free to proceed, because very important discoveries of higher grade ores have been made in the lower levels of the Anaconda and Parrot mines, and because great activity has been aroused in the development of properties long dormant or hardly explored.

The long continued harassing litigation in the Butte copper camp was ended through the intervention of Messrs. Thomas F. Cole, of Duluth, and John D. Ryan, president of the Amalgamated Copper Company, there being transferred to the Butte Coalition Mining Company all the property of the United Copper Company, including the mines and the smelter of the Montana Ore Purchasing Company, the Minnie Healey, Corra, Rock Island, Nipper, Belmont, Johnstown, Hypocka, and Guardian mines. It does not include the La France Copper Company, consisting of the Lexington mines, or the Basin concentrator. The operations of the new company in Montana will be conducted by the Red Metal Mining Company.

In recent years the absence of detailed company reports has made it difficult to judge of the capacity of the Butte district to produce copper cheaply. Particular interest attaches, therefore, to the report of the Anaconda Mining Company for 1905, the first published for a number of years. The mines of the company produced 1,543,316 short tons of ore, of which 61,149 dry tons of smelting ore remained on hand at the reduction works. The mining expenses, including development and depreciation, aggregated $5,403,585, or $3.50 per ton; transportation to the reduction works $226,515, or 14.7 cents per ton; reduction expenses at Anaconda, including depreciation of $4,046,822, or, approximately, not counting other materials smelted, $2.62 per ton, and $1,729,175, or $1.11 per ton for freight, marketing, and refining. The yield of the material treated, including 1,470,694 tons of ore and 155,612 tons of slimes, flue dust, and slags, amounted to 95,443,730 pounds of copper, or 59.9 pounds to the net ton, or practically 3 per cent of copper, 3,116,881 ounces of silver, and 19,165 ounces of gold. The total outlays were $11,810,054, or equal to 12.37 cents per pound of copper, against which must be credited, however, the amount obtained for the precious metals. This would figure about 2.42 cents per pound of copper, leaving the cost at close to 10 cents per pound.

Developments not important to the Anaconda alone, but to the entire Butte district, have been made at the 2,200 and 2,400 levels in the Anaconda and also in the Parrot mine. In the whole camp low-grade pyrites have been encountered at depths varying from 1,000 to 1,500 feet. This material, between the 1,200 and 2,200 foot levels of the Anaconda, barely carried 2 per cent of copper. No official reports relative to the grade opened in the Anaconda have been made, but it is reported that they carry 6 per cent of copper.

Besides treating Anaconda ores, the Washoe reduction works handle large quantities of ores from other mines on contract, the total quantity treated being 2,650,868 tons of ore and cuprous material. The works are capable of handling 4,700 tons of material. Originally there were seven blast furnaces, 18 feet long, 16 feet apart. Two each were coupled together, making them 52 feet long; this system increased the capacity of each couple by about 800 tons per day. It is proposed further to enlarge the plant. The old reverberatory furnaces have been replaced by large ones, the works now having two furnaces 102 feet long, four 112 feet long, and one 115 feet long, all equipped with boilers, which furnish, from the waste heat, all the steam to operate the smelter boiler house. With an enlarged capacity and a higher grade of ore the output should show a very material increase. The Boston and Montana Company, also controlled by the Amalgamated Copper Company, produced in 1905 101,482,156 pounds of copper. The two plants, the Washoe and the Great Falls works, now have a capacity of 12,000 tons of ore per day.

The production of the United Copper Company was somewhat less in 1905 than it was in 1904, and the same holds true of the Butte reduction works. A small quantity of copper was produced at the smelting works of the Pittsburg and Montana Company, which, however, have since been shut down. The mines of the company continue to ship ore.

The first annual report of the North Butte Mining Company gives full data with reference to this property, which has so suddenly leaped into prominence. The company was organized in April, 1905, to purchase the Speculator properties, consisting of the Speculator, Edith May, Jesse, Copper Dream, and Miners' Union mines. Subsequently there were acquired the Berlin, Gustavus, Margaretha, Leap, Eva, Hancock, Ground Hog, and Adirondack claims. The company has enlarged and retimbered the Speculator shaft, has pushed work in the Edith May and Jessie mines, has opened up ore bodies in the Miners' Union and Hancock claims, and is installing at the Speculator shaft a modern hoisting engine to operate to a depth of 3,500 feet, and a compressor plant capable of furnishing 3,500 cubic feet per minute. This new equipment will enable the company to increase the quantity of ore hoisted from 900 to 1,500 tons per day. The company has been shipping under contract to the Washoe Copper Company's smelter, and during the year delivered ore carrying 30,954,788 pounds of metal. Settlements for the copper were made on an average price of 16.47 cents. The gross value of all the ores produced for the year, including $679,255.30 gold and silver, was $5,005,788.39. The total operating cost, including new machinery, improvements, mining expenses, smelter charges, freight, etc., was $2,285,117.61, leaving the net value of the metals $2,720,670.78. The company distributed in dividends $1,000,000.

ARIZONA.

The rapid strides in the development of the copper production which Arizona made in 1904 continued in 1905, the increase being slightly larger. It was particularly in the Bisbee, Globe, and Jerome districts that the growth was most striking, the Clifton district showing only a slight change, owing to floods. The quantity of Arizona ores smelted by the American Smelting and Refining Company was large.

Bisbee district.—In the Bisbee district the Copper Queen produced 38,500 tons, exclusive of what was put into stock, but including 5,500,000 pounds of Copper Queen copper in the form of sulphide ore shipped to Globe. The output of the smelting works at Douglas was 40,488 tons, the plant handling considerable custom ore and treating also Mexican concentrates. An increase in the size of the plant of about 50 per cent has been planned and is nearly completed. Doctor Douglas states, however, that the increase is intended more as a safeguard against temporary interruption than as a means of increasing the capacity of the works to a proportionate extent.

The product of the Calumet and Arizona Mining Company amounted to 31,772,896 pounds, the product in gold and silver being $178,843.58, an average of $11.26 per ton of refined copper. The copper produced from October 1, 1904, to September 30, 1905, sold at an average of 14.932 cents per pound, this being all that was ready for delivery at the electrolytic works to December 31, 1905. On October 15, No. 3 furnace was started on ores furnished by the Lake Superior and Pittsburg and the Pittsburg and Duluth Mining companies. The fourth furnace, to be held in reserve, was completed on December 23.

There were smelted during the year 202,952 tons of ore, from which there was recovered 7.91 per cent of copper. During the year development work amounted to 21,737 feet, of which 18,775 feet was drifting. At the Oliver shaft a four-cylinder, double-reel, flat-rope hoisting engine is being installed which is designed to serve to a depth of 2,500 feet. Electric pumping and hauling machinery is being installed. The company paid in 1905 $1,700,000 in dividends, and its financial statement showed an excess of assets over liabilities of $2,438,260.96.

The Lake Superior and Pittsburg Mining Company produced during the last two and one-half months of the year 1905 1,721,295 pounds of copper from 11,467 tons of ore, a yield of 7.90 per cent. The product of gold and silver was $5,418.23, an average of $6.30 per ton of refined copper. The company is sinking the Cole shaft to a depth of 1,500 feet. The surface plant is not yet in a satisfactory condition. The financial statement shows an excess of assets over liabilities of $201,936.42.

The Pittsburg and Duluth Mining Company began shipping ore to the smelter in October, and obtained from 7,069 tons 390,179 pounds of copper and $5,589.07 of silver and gold. The ore is low in grade, 3.232 per cent, but it is used as a flux for the Lake Superior and Pittsburg ores and a premium is paid on it. From diamond drill exploration it is known that the mine carries ores higher in grade.

The Calumet and Pittsburg Mining Company and the Junction Mining Company are still in the exploring and development stage.

Large ore bodies have been developed during the year by the Shattuck Arizona Mining Company.

Globe district.—In the Globe district the principal producer, the Old Dominion Company, showed a marked increase in output, from 15,368,147 pounds in 1904 to 28,919,217 pounds in 1905. The company, however, did not secure in the latter year the full benefit of its enlarged plant, which gives it a capacity of 3,000,000 pounds of copper per month. That capacity is being enlarged by increasing the concentrating mill and adding a fourth blast furnace and one or more reverberatory furnaces. These betterments are expected to bring the output up to close to 4,000,000 pounds per month.

The Arizona Commercial Company, also in the Globe district, is developing chiefly two groups of mines, the Copper Hill and the Black Hawk, and is shipping to the Old Dominion smelter a moderate tonnage of ore, the output being limited by the transportation facilities. Since these are to be improved the company will become a larger producer.

Clifton district.—The Arizona Copper Company in common with all the producers of the Clifton district suffered by numerous floods, which also delayed the improvements and extensions at the concentrators. The new concentrating plant at Morenci, with a daily capacity of 700 tons, is expected to go into commission in May, thus materially adding to the output. Important developments of high-grade concentrating ore have been made in the Coronado mine, and a low-grade ore body, 110 feet in width, has been developed in the Humboldt mine. The financial results for the fiscal year ending September 30, 1905, showed sales of copper £816,728, railroad earnings £142,548, and interest and fees £1,273, or total receipts of £960,549. The mining costs aggregated £276,327, smelting £215,847, general expenses £14,431, and railroad expenses £69,969. This made the earnings £383,975, but of this £22,877 was paid out for interest and income tax, £500,000 was placed to reserve, and £24,531 was paid in dividends.

The operations during the half year ending September 30, 1905, showed that 302,003 tons of first class and concentrating ores were treated, the average yield of all the ores being 2.38 per cent. The smelting works handled 57,694 tons of ore and concentrates and 1,209,082 pounds of copper obtained from the leaching plant, the product being 14,351,477 pounds of copper for the period of six months.

The Detroit Mining Company, owned by Phelps, Dodge & Co., is doubling the capacity of the existing concentrator, an improvement which will be completed before the close of the year 1906. The mine produced in 1905 14,545,497 pounds of copper, as compared with 16,456,000 pounds in 1904.

The Shannon Copper Company, the third producer in the Clifton district, has been showing some progress, but has been forced to handle ore lower in grade. This is reflected in the annual report for the fiscal year ending August 31, 1905, which shows that the average contents was 4.08 per cent, or 0.39 per cent less than the previous year. The product of the mine, 188,856 tons, consisted of 53,353 tons of smelting ore, carrying 5.15 per cent of copper, and 135,503 tons of concentrating ore, averaging 3.66 per cent. The cost of mining was $2.138 per ton. The concentrating plant ran only two-thirds of the time owing to floods. The furnace plant put through 128,724 tons, including 52,926 of Shannon ore, 29,735 tons of concentrates, 3,831 tons of fine ore, and 3,519 tons of custom ore. The product was 11,414,271 pounds of fine copper, as compared with 10,788,891 pounds for the previous year. In addition, 592 ounces of gold and 17,127 ounces of silver were sold. The gross receipts from sales were $1,631,317, while operating expenses were $1,126,248, selling and miscellaneous expenses were $241,772, and outlays for construction and development amounted to $52,321. The company has completed a converting plant.

The New England and Clifton Copper Company has begun active mining operations, having made a contract with the Shannon Company to treat its ore.

Jerome district.—In the Jerome district the United Verde smelter was in operation continuously and the property yielded a larger output. Improvements are under way which will lead to some increase. The production of the Equator Company was not large.

The Arizona Smelting Company is contemplating a custom smelting plant at Humboldt, which is expected to stimulate production in Yavapai County.

The Silver Belt, formerly known as the Old Boot mine, has been shipping steadily to the Copper Queen works at Douglas, and the Helvetia has resumed mining and smelting and is expected to enlarge its operations.

UTAH.

Utah is on the eve of very important additions to output, chiefly owing to the erection of a number of large mills to treat the low-grade ores of the Bingham district and to the building of a very large copper-smelting plant at Garfield by the American Smelting and Refining Company. During the year 1905 the three largest producers—the Utah Consolidated, the United States, and the Bingham—showed substantial gains, and the copper produced from Utah ores, obtained by the existing smelting works of the American Smelting and Refining Company, was also considerably larger.

The operations of the Utah Consolidated Company were on a larger scale in 1905, the company having treated 286,200 tons of ore, yielding 17,264,474 pounds of copper, 374,685 ounces of silver, and 28,290 ounces of gold. In 1904 the product was 13,553,483 pounds of copper. The sales amounted to $3,361,080 and the expenses to $1,473,695, leaving a profit of $1,887,385, as compared with $1,164,348 in 1904. The development of the mine has increased the reserves and the reverberatory furnaces at the smelting works have been rebuilt, with a resultant decrease in the cost of operation. The problem of treating the smelter gases has been dealt with, an experimental plant handling one-twentieth of the gases being in operation.

The Utah Copper Company is carrying out very extensive plans for the development of its mines and the treatment of its ores. The first unit of a concentrating plant with a capacity of 3,000 tons per day is under construction on the shore of the Great Salt Lake. The ore as developed shows by extensive sampling and mill tests an average of 1.98 per cent of copper, 0.016 ounce of silver, and 0.15 ounce of gold. It is expected that the cost of copper will be 8 cents per pound. During the year ending June 30 the mine and the older 500-ton mill yielded a profit of $198,738, and $56,250 being deducted for interest and taxes, showed a surplus of $142,488.

An interesting estimate of the cost of handling the low-grade porphyry ores of the Bingham district is attributed to Mr. Samuel Newhouse, president of the Boston Consolidated Company, on the basis of a concentrating plant handling 2,500 tons per day: Mining with steam shovels, 40 cents per ton; milling, 35 cents; smelting, 20 cents; freight and refining, 42 cents; selling and general expenses, 16 cents; total, $1.78. With a copper content of 1.4 per cent in the crude ore and a recovery of 75 per cent in concentrating, and assuming copper at 12 cents, the copper yield would be $2.52. To this would be added 20 cents per ton for silver and gold, and a yield of $2.72 would be reached, which would leave a profit of 94 cents per ton of crude ore. The cost of the plant would be $1,125,000, on which interest at 6 per cent and depreciation at 10 per cent would figure 24 cents per ton of crude ore.

Very extensive plans are being worked out by the Boston Consolidated Copper Company to utilize the porphyry ores, of which a very large body is exposed on the property. These ores, which are to be mined in open pits by steam shovels, carry about 2 per cent of copper. It is proposed to build a concentrating mill at Garfield capable of handling 3,000 tons of rock per day. The Boston company also owns a deposit of sulphides in which some important bodies of high-grade ore have been opened up lately. For some years the company has been shipping small quantities of sulphides to the Bingham smelter, the production during the fiscal year ending September 30, 1905, having been 43,717 tons, for which the company received $299,193, and from which a net profit of $172,158 was secured. A contract has been made with the American Smelting and Refining Company for the delivery of 750 tons of ore per day to the smelting works now building at Garfield.

The Yampa smelting plant of the Tintic Mining Company has been rebuilt, and now consists of two blast furnaces and a reverberatory.

The Nevada-Utah Company, which operates the Last Chance, in Bingham Canyon, and properties at Pioche, Nev., is to start a mill on the Last Chance ores in 1906.

The Cactus mine, in Beaver County, is owned by the Newhouse Mines and Smelters Corporation. The large new mill went into operation in March and handled 135,000 tons of ore, from which 311 cars of concentrates were produced, the product being smelted by the American Smelting and Refining Company.

CALIFORNIA.

The Mammoth Copper Mining Company, now controlled by the United States Smelting, Refining and Mining Company, has built a new smelting plant at Kennett, Shasta County, with three water-jacket furnaces, which were started toward the close of the year. The matte is shipped for further treatment to the Utah works of the company. It is probable that two additional furnaces and mechanical roasting furnaces will be added to the plant during 1906.

Smelting at the Keswick works of the Mountain Copper Company was discontinued in May, and some of the machinery was removed to the new smelting works at Bulls Head Point, Suisun Bay, near San Francisco, where operations began toward the end of the year. The result has been that production was much less than in recent years. The profits for 1905 were $790,840, as compared with $1,004,470 for 1904. The company has built an acid and a fertilizer plant.

The Balaklala Copper Company, which controls another Shasta County property, has been taken in hand by strong parties, who are to build a smelting plant to treat 1,000 tons per day. The matte produced will probably be shipped to San Francisco for further working.

A very large copper smelting plant to handle customs ore is to be built by the American Smelting and Refining Company at Point San Bruno, Cal.

NEVADA.

Very important developments are being made in the Ely district, where strong interests have combined the New York and Nevada and the White Pine companies under the title of the Nevada Consolidated Copper Company to work the copper-bearing porphyry. A large concentrating plant is to be built. A second property is the Giroux Consolidated Mines Company, which is building smelting works, and a third group is the Cumberland Ely Mining Company.

ALASKA.

In Alaska two plants, the Alaska Smelting and Refining Company, of Hadley, and the Alaska Copper Company, of Coppermount, started smelting operations toward the close of the year. Hitherto the Alaska copper ores have gone to distant smelters. With local plants production will probably increase materially.

THE SOUTH.

The Tennessee Copper Company produced in 1905 7,977,982 pounds of copper, the enlarged smelting plant having been practically completed toward the close of the year. The company is now in a position to handle 500,000 tons of ore per annum, equivalent to a production of 18,000,000 pounds of pig copper, which it is expected will cost about 7.5 cents per pound free on board New York. During the year 1905 the cost of producing and marketing was 9.28 cents per pound. The profit for the year was $452,106, after charging $62,042 for depreciation. Out of surplus and profits, $584,103 was expended for new construction, about $500,000 of this amount being devoted to the smelting plant. The ore reserves during the year were increased to 4,000,000 tons.

In Massachusetts the New England Mining Company has started a smelter at Greenfield.

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, 1903–1905.

[Long tons.]

Country.	1903.	1904.	1905.
EUROPE.			
Great Britain	536	495	a 500
Spain and Portugal:			
Rio Tinto	35,810	33,480	32,280
Tharsis	6,320	5,620	4,345
Mason and Barry	2,430	2,950	2,720
Sevilla	1,105	1,330	1,280
Tinto and Santa Rosa	1,430	} 3,655	} 4,185
Other mines	2,645		
Germany:			
Mansfeld	18,975	18,735	19,565
Other German	2,230	2,310	2,595
Austria	1,055	1,275	1,175
Hungary	330	175	150
Sweden	455	390	550
Norway	5,915	5,415	6,305
Italy	3,100	3,335	2,950
Russia	10,320	10,700	8,700
Turkey	1,400	950	950
Total	94,056	90,815	88,250
NORTH AMERICA.			
United States	311,627	362,739	402,637
Canada	19,321	19,183	25,000
Newfoundland	2,710	3,921	4,000
Mexico:			
Boleo	10,480	10,945	10,185
Other Mexican	a 40,000	a 50,000	a 60,000
Cuba	....	490	1,000
Total	384,138	447,478	502,822
SOUTH AMERICA.			
Chile	30,930	30,110	29,165
Bolivia:			
Corocoro	a 2,000	a 2,000	a 2,000
Peru	9,496	9,504	8,625
Argentina	135	155	155
Total	42,561	41,769	39,945
AFRICA.			
Algiers	....	....	....
Cape of Good Hope:			
Cape Company	4,630	5,475	5,025
Namaqua Company	600	2,300	2,300
Total	5,230	7,775	7,325
ASIA.			
Japan	31,360	34,850	35,910
AUSTRALASIA.			
New South Wales	8,135	6,785	a 7,000
South Australia	7,200	6,875	a 7,000
Tasmania	8,547	8,583	a 8,500
Queensland	4,916	4,370	a 4,500
Total	28,798	26,613	27,000
Grand total	586,143	649,300	701,252

a Estimated.

Copper production of the world, 1899–1905.

[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	586,143	384,138	202,005
1904	649,300	447,478	201,822
1905	701,252	502,822	198,430

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) was given.

Since July, 1903, the Bureau of Statistics of the Department of Commerce and Labor has collected data relative to the copper content of ores and mattes imported into this country, and thus a serious source of uncertainty has been removed.

For the calendar years 1904 and 1905 the imports were as follows:

Imports of copper ore and matte in 1904 and 1905, by countries.

[Pounds.]

Imported from—	1904.			1905.		
	Quantity.	Copper content.	Value.	Quantity.	Copper content.	Value.
United Kingdom	....	....	....	73,920	47,638	$7,349
Germany	6,720	4,573	$1,033	....	....	....
British North America	410,148,480	15,046,131	1,453,575	394,656,640	15,403,429	1,573,720
Mexico	156,652,160	20,803,961	2,522,795	220,109,120	28,890,239	3,472,264
South America	371,840	91,509	10,508	8,202,880	1,503,427	210,144
Other countries	33,664,960	3,001,548	320,167	40,559,680	4,260,567	501,761
Total	600,844,160	38,947,722	4,308,078	663,602,240	50,105,300	5,765,238

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, 1904, and 1905:

Imports of copper pigs, bars, ingots, plates, old and other unmanufactured, in the calendar years 1901–1905, by countries.

[Pounds.]

Country.	1901.	1902.	1903.	1904.	1905.
France	1,022,178	843,523	1,426,279	22,075	1,549,138
Germany	3,117,951	1,245,354	1,600,766	875,329	2,945,441
United Kingdom	43,838,699	27,762,838	18,788,558	19,172,854	26,284,302
Other Europe	....	255,072	240,689	16,943	1,955,358
British North America	953,576	386,361	15,923,760	17,690,656	23,636,843
Cuba	1,013,460	801,016	467,832	368,634	433,440
Other West Indies	390,201	190,972	317,112	373,734	278,502
Mexico	23,024,376	68,565,175	89,361,100	97,965,593	102,646,343
Japan	224,850	2,643,913	3,604,643	80	....
All other countries	241,115	435,344	4,477,256	5,858,535	890,018
Total	73,826,406	103,129,568	136,707,995	142,344,433	160,619,385
Value	$11,812,216	$13,051,159	$17,262,148	$18,374,941	$22,103,741

Of this quantity of copper 4,561,142 pounds, valued at $574,618, is old copper, fit only for remanufacture. The remainder is in the form, largely, of converter bars, which are handled in our seaboard refineries, which are more and more drawing raw material to them from all parts of the world.

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 for the calendar years 1901–1905.

Copper and copper ore of domestic production exported from the United States, 1901–1905.

[Pounds.]

Year.	Ore and matte.		Pigs, bars, sheets, and old.		Value of manufactured product.	Total value.
	Quantity.	Value.	Quantity.	Value.		
1901	24,602,592	$2,536,549	194,249,828	$31,692,563	$1,842,336	$36,071,448
1902	40,398,400	1,326,131	354,668,849	43,392,800	2,092,798	46,811,729
1903	27,531,840	855,367	310,729,524	41,170,059	2,339,729	44,365,155
1904	42,396,480	1,202,537	554,550,030	71,488,116	3,328,818	76,019,471
1905	84,421,320	1,531,429	534,907,619	80,693,232	4,184,070	86,408,731

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 the years 1900–1905, and countries to which exported.

[Pounds.]

Country.	1900.	1901.	1902.	1903.	1904.	1905.
United Kingdom	63,522,445	36,819,100	88,972,029	47,140,717	112,224,871	60,945,794
Belgium	12,554,191	4,561,405	8,431,560	4,207,720	9,365,791	4,997,206
France	67,725,989	34,607,042	63,519,881	53,745,221	99,888,455	74,604,044
Germany	67,348,848	37,487,180	56,604,753	71,130,077	103,825,445	104,575,864
Netherlands	101,398,394	61,752,002	96,358,472	96,927,346	147,678,581	130,675,386
Italy	5,550,285	5,045,775	9,108,904	7,774,016	15,297,091	15,800,967
Russia	5,650,423	2,889,270	[a]28,539,742	10,411,679	22,333,578	18,418,982
Austria	11,258,115	8,616,964		[b]16,516,663	29,064,494	25,279,162
Mexico	296,684	217,437	251,812	165,283	191,429	290,763
British North America	1,616,778	1,232,577	2,811,835	2,644,831	3,472,614	3,019,450
West Indies	1,317	3,032	97			79,940,250
China					10,403,034	16,359,751
Other countries	1,050,282	1,018,044	69,764	63,971	804,647	
Total	337,973,751	194,249,828	354,668,849	310,729,524	554,550,030	534,907,619

[a] Other Europe, including Austria and Russia. [b] Other Europe.

The figure of greatest interest in the exports for 1905 is that relating to the shipments to China, which, however, practically ceased in that year.

The following table, prepared by the Bureau of Statistics, shows the ports from which copper was exported:

Domestic exports of ingots, bars, and old copper in 1901–1905, by ports.

[Pounds.]

District.	1901.	1902.	1903.	1904.	1905.
Baltimore, Md	54,377,355	103,607,256	88,296,071	171,386,493	160,006,001
Boston and Charlestown, Mass.	27,917	426,069	512,053	838,321	383,811
Newport News, Va	1,568,567	5,070,026	1,969,177	7,626,951	6,002,955
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	332,569,733
Philadelphia, Pa	3,526,130	5,804,743	3,845,307	9,718,814	2,486,003
New Orleans, La	1,806	1,819	3,014	121,835	1,208,926
Puget Sound	1,244	2,681	3,698	62,789	28,352,769
Detroit, Mich	387,923	812,828	611,327	1,187,706	1,032,541
Huron, Mich	92,062	208,849	261,820	532,841	597,712
Burlington, Vt	434,692	....	491,921	700,561	264,377
All other districts	291,982	1,513,724	1,084,088	1,168,896	2,002,791
Total	194,249,828	354,668,849	310,729,524	554,550,030	534,907,619

The data submitted permit of the following summary, showing the available supply of copper for the years 1901 to 1905, both inclusive:

Supply of copper for the United States, 1901–1905.

[Pounds.]

Source.	1901.	1902.	1903.	1904.	1905.
Production of domestic copper	602,072,519	659,508,644	698,044,517	812,537,267	901,907,843
Imports:					
Fine copper in ore and matte, entered for consumption	[a]64,000,000	[b]40,000,000	[a]32,000,000	38,947,772	50,105,300
Bars, ingots, and old copper	73,826,406	103,129,568	136,707,995	142,344,433	160,619,385
Total	739,898,925	802,638,212	866,752,512	993,829,472	1,112,632,528
Exports:					
Ingots and bars—					
Domestic	194,249,828	354,668,849	310,729,524	554,549,880	534,907,619
Foreign	12,888,083	11,629,877	2,093,103	1,088,672	1,718,584
Fine copper content of matte	[a]15,000,000	[a]11,000,000	[a]7,500,000	[a]12,000,000	[a]16,000,000
Total	222,137,911	377,298,726	320,322,627	567,638,552	552,626,203
Available supply	517,761,014	425,339,486	546,429,885	426,190,920	560,006,325

[a] Estimated. [b] Deducting estimated content of foreign matte exported.

STOCKS.

Partial returns have been received relative to the stocks carried by producers, by first hands. The blanks call for the 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 those carried by merchants for their own account, nor those carried by consumers at their factories. According to these returns copper companies, which during 1905 produced 447,480,819 pounds of copper, reduced their stocks on hand from 95,062,862 pounds on January 1, 1905, to 73,941,814 pounds on January 1, 1906.

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 1901, 1902, 1903, 1904, and 1905 being as follows:

Estimated consumption of copper in the United States in 1901–1905.

[Pounds.]

	1901.	1902.	1903.	1904.	1905.
Available supply	517,761,014	425,339,486	546,429,885	426,190,920	560,006,325
Deduct increase in producers' stocks.	135,000,000	....	20,000,000	....	....
Add decrease in producers' stocks	....	126,348,645	....	56,000,000	21,000,000
Estimated consumption	382,761,014	551,688,131	526,429,885	482,190,920	581,006,325

This is based on the assumption that, for the year 1905, for instance, the producers of half the copper made in the United States in that year, who did not report their stocks, did not materially reduce them. The probabilities are, of course, that in heir case a similar falling off took place and that probably in reality the consumption of copper in the United States was close to 600,000,000 pounds in 1905.

PRICES.

The following table shows the highest and lowest prices, monthly, during the last five years:

Highest and lowest prices of Lake Superior ingot copper, by months, 1901–1905.

[Cents per pound.]

Year.	January.		February.		March.		April.		May.		June.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
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	12½	12¼	13	12½	13⅝	13	13⅜	12⅞	13⅛	12½
1905	15¼	15	15¼	15⅛	15¼	15⅛	15¼	15	15	14⅝	15	14¾

Year.	July.		August.		September.		October.		November.		December.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
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
1905	15¼	15	16½	15⅜	16⅜	16	16½	16	17½	16½	19	18

From the annual reports of some of the Lake Superior companies it is possible, by a comparison of the total quantity of copper sold by these companies with the total amount received from such sales, to obtain a close estimate of the average selling price of Lake copper. The following table gives the results for 1902, 1903, 1904, and 1905:

Average selling prices of Lake copper in 1902, 1903, 1904, and 1905.

Mine.	1902.		1903.		1904.		1905.	
	Quantity sold.	Average price per pound.	Quantity sold.	Average price per pound.	Quantity sold.	Average price per pound.	Quantity sold.	Average price per pound.
	Pounds.	*Cents.*	*Pounds.*	*Cents.*	*Pounds.*	*Cents.*	*Pounds.*	*Cents.*
Tamarack	15,961,528	11.87	15,286,093	13.02	14,961,885	13.24	15,824,008	15.47
Osceola	13,416,396	11.78	16,059,636	13.00	20,472,429	13.19	18,938,965	15.54
Atlantic	4,949,366	11.88	5,505,578	13.12	5,321,859	13.34	4,049,731	15.86
Isle Royale	3,569,748	11.91	3,134,601	13.12	2,442,905	13.19	2,973,761	15.53
Baltic	6,285,819	11.87	10,580,997	13.43	12,177,729	12.99	14,384,684	15.62
Champion			10,564,147	13.37	12,212,954	13.03	15,707,426	15.56
Trimountain			9,237,051	13.43	10,211,230	13.67	10,478,462	15.47
Winona			1,039,944	13.49	642,025	13.66		
Quincy			18,498,288	13.24	18,343,160	13.48	18,827,557	15.83
Franklin			4,712,388	13.72				
Mohawk							9,387,614	15.53
Michigan							2,891,796	15.69
Mass							2,007,950	16.43
Allouez							1,167,957	16.67
Adventure							1,606,208	15.72
Centennial							1,446,584	15.91
General average		11.86		13.26		13.21		15.63

The following table shows the fluctuations in prices in the English market:

Average value of copper in England, 1901–1905.

[Per long ton.]

Year.	Standard copper.			Best selected copper.		
	£	*s.*	*d.*	£	*s.*	*d.*
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
1905	69	12	0½	74	5	10

THE COPPER MARKET IN 1905.

During the first six months of the year the market hovered near the level of 15 cents per pound for Lake copper, consumers during that time acting very conservatively. It was not until July that buyers began to realize, through the scarcity of spot copper, that the large production was being absorbed and that stocks were low. April and May brought repeated rumors that copper sold for shipment to China was being resold, but these reports proved unfounded. In July very heavy sales for forward delivery were made, contracts in some cases extending to May, 1906. With an unsatisfied demand pressing the market, the price rose as high as 16.50 cents for spot Lake copper in August, but further rumors of resales and a less animated market caused an easing in September to 16 cents, followed quickly, however, by a resumption of the upward movement. Heavy buying again set in during the latter part of November, carrying the market up to 17½ cents. Another spurt followed in the early part of December, the price rising as high as 19 cents in that month.

LEAD.

By Charles Kirchhoff.

INTRODUCTION.

The year 1905 was characterized by a very heavy consumptive demand, bordering on famine toward the close of the year, advancing prices, and a considerably enlarged though inadequate domestic production. The lead interests of the country underwent further strides in the direction of greater concentration. The American Smelters Securities Company was organized, which acquired the hitherto independent Pacific coast smelters, and in September the same corporation took over the Federal Mining and Smelting Company, controlling large mining properties in the Coeur d'Alene district. A long-time contract was also made for the product of the Bunker Hill and Sullivan mines in the same district.

The United States Mining, Smelting and Refining Company has put into operation an independent smelting plant at Bingham Junction, Utah, and is building a lead refinery at East Chicago.

The principal outside interests now are a group of larger mines in southeast Missouri, with the St. Joseph Lead Company as the largest, and the producers of lead in southwest Missouri and Kansas, the greater part of whose output, practically an incident to zinc mining, goes to local smelters, conspicuous among whom are the Picher, Galena, and Granby companies. There are two independent refining plants, the Pennsylvania and the Ballach, the latter handling largely foreign base bullion.

PRODUCTION.

The following distribution of the production of lead by States and Territories has been arrived at from returns made to this office by the smelting works, in the absence of statistics obtained directly from the mines. These returns for a series of years aggregate as follows:

Lead content of ores smelted by the works in the United States, 1894–1905, by States.

[Short tons.]

State or Territory.	1894.	1895.	1896.	1897.	1898.	1899.
Colorado	50,613	46,984	44,803	40,576	57,352	70,308
Idaho	33,308	31,638	46,662	58,627	59,142	52,154
Utah	23,190	31,305	35,578	40,537	39,299	29,987
Montana	9,637	9,802	11,070	12,930	10,745	10,227
New Mexico	2,973	3,040	3,461	9,123	5,797	4,856
Nevada	2,254	2,583	1,173	959	4,714	3,388

Lead content of ores smelted by the works in the United States, 1894–1905, by States—Con.

State or Territory.	1894.	1895.	1896.	1897.	1898.	1899.
Arizona	1,480	2,053	1,165	2,184	2,224	3,377
California	478	949	691	383	482	487
Washington	150	381	1,006	638	1,349	862
Oregon, Alaska, South Dakota, Texas						
Missouri, Kansas, Wisconsin, Illinois, Iowa, Virginia, and Kentucky	46,300	53,596	51,887	56,542	54,469	54,444
Total lead content American ores smelted	170,383	182,331	197,496	222,499	235,573	230,090
Content Mexican ores	[a] 21,000	16,437	15,403	13,430	10,520	10,293
Content Canadian ores		5,040	10,100	19,515	17,377	5,110
Content miscellaneous or unknown	....	....	2,118	344	428	772

State or Territory.	1900.	1901.	1902.	1903.	1904.	1905.
Colorado	82,137	73,265	51,833	45,554	51,884	56,638
Idaho	85,444	79,654	84,742	99,590	108,854	99,027
Utah	48,044	49,870	53,914	51,129	56,470	44,996
Montana	....	5,791	4,438	3,303	3,635	2,207
New Mexico	....	1,124	741	613	1,363	1,232
Nevada	....	1,873	1,269	2,237	1,873	2,206
Arizona	....	4,045	599	1,493	1,499	2,091
California	520	381	175	55	163	116
Washington	....	1,029	1,457	538	622	56
Oregon, Alaska, South Dakota, Texas			2,184	1,765	41	101
Missouri, Kansas, Wisconsin, Illinois, Iowa, Virginia, and Kentucky	....	67,172	79,445	86,597	92,275	104,058
Total lead content American ores smelted	....	284,204	280,797	292,874	318,679	312,728
Content Mexican ores	....	11,841	8,755	56,890	24,952	....
Content Canadian ores	....	9,615	2,164	253	11	....
Content miscellaneous or unknown	....	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 1905 this total of 104,058 short tons embraced 103,116 short tons of pig lead smelted directly by nonargentiferous smelters and 942 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 312,728 tons in the table, but to a quantity less by 103,116 tons of merchant pig lead, or to 209,612. Of this latter quantity, 95 per cent, or 199,131 short tons, may be estimated as the merchant lead product of the lead contained in the ores mined in the United States during 1905. Adding the 103,116 tons of soft lead directly produced in the Mississippi Valley, a total is reached of 302,247 short tons. In order to indicate that it is an approximation the rounded figure of 302,000 tons is accepted as representing the lead production of the United States from domestic ores for the year 1905.

Redistributing this total pro rata among the States and Territories which yielded plumbiferous ores in 1905, the following figures are reached as the probable production of merchant lead assignable to each, compared with 1904:

Production of merchant lead, by States, 1903, 1904, and 1905.

[Short tons.]

State or Territory.	1903.	1904.	1905.
Colorado	43,276	49,290	53,806
Idaho	94,611	103,411	94,076
Utah	48,573	53,647	42,746
Montana	3,138	3,454	2,097
Nevada	2,125	1,779	2,096
New Mexico	582	1,295	1,170
Arizona	1,418	1,424	1,986
California	52	155	110
Washington	511	591	53
Alaska, Oregon, South Dakota, etc	1,677	39	96
Mississippi Valley and Southern States	86,439	92,119	104,011
Total	282,402	307,204	302,247

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 quantity 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, 1883–1905.

[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

[a] Including foreign base bullion refined in bond.
[b] Including a small quantity of lead produced in the Southern States.
[c] Estimated.

Production of refined lead in the United States, 1883–1905—Continued.

Year.	Total production.	Desilverized lead.	Soft lead.	From foreign ores and base bullion.
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
1905	399,302	296,186	103,116	80,793

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, to 11,001 tons in 1904, and to 10,995 tons in 1905.

According to the direct returns of the smelters and refiners the imports of lead consisted of 55,444 short tons of base bullion and 25,349 tons of lead in foreign ores, equivalent to about 79,500 tons of lead. Deducting this from the total production of pig lead in 1905 of 399,302 short tons, we arrive at an estimate of about 320,000 short tons as the make of lead in 1905 from ores mined in the United States. The estimate of 302,000 tons adopted by this office has been accepted as probably most closely representing the true quantity, allowance being made for ores in transit and in course of treatment.

DOMESTIC PRODUCERS.

The production of the Mississippi Valley showed a further satisfactory increase during 1905. In the lead-zinc region of southwest Missouri and southeast Kansas the quantity of lead concentrates obtained in mining for zinc, the mineral of larger value, was slightly less than it had been during the year 1904. The local smelting plants—the Picher Lead Company, the Galena Smelting and Manufacturing Company, and the Granby Mining and Smelting Company—produced in 1905 21,296 short tons of pig lead, as against 19,581 tons in 1904, and 17,343 tons in 1903. A somewhat larger tonnage of ore than formerly was therefore derived from local smelters.

The principal increase in the production of soft lead has taken place, however, in southeast Missouri, where the largest producer, the St. Joseph Lead Company, considerably increased its output. The Federal Lead Company, which is controlled by the American Smelting and Refining Company, and which owns the Derby and Federal mines in the Flat River district and the smelting mines near St. Louis, acquired the mines, concentrator, and smelting plant of the Central Lead Company. This company when in full operation has produced about 5,500 tons of lead per annum. The Desloge, Madison, North American, and National mines were in full operation. The Mine la Motte made a product close to that of its former days. Throughout the southwest Missouri district there is great activity in prospecting land with the diamond drill, and with old properties expanding and new mines falling into line the output is likely to show a steady development.

The year 1905 has been one of great activity in the Cœur d'Alene region, which so far as output is concerned has been confined almost entirely to the old mines. These have developed further large and rich borders in the deepest levels, notably in the Morning mine at Mullan, acquired during 1905 by the Federal Mining and Smelting Company, the Mace mine owned by the same interest, the Hecla, at Burke, and the

Bunker Hill and Sullivan, at Wardner. Some shipments have been made by smaller producers, which are being opened up in order to prepare them for more extensive operations.

Leadville continues a heavy producer of lead, the camp contributing a little over one-half of the total of Colorado. The principal shipping mines in 1905 were the group controlled by the Western Mining Company, a Guggenheim interest, with the Coronado, the A. M. Co., and the A. Y. and M., the New Monarch, controlled by the same parties who operate the independent Ohio and Colorado smelter at Salida, the Reindeer, and the Ibex. Extensive tunnel operations are opening up large bodies of low-grade ores in Leadville, not hitherto available on account of the cost of pumping, and the better price obtained for silver is making moderately profitable ores which could only be mined at a loss. The Aspen district in Pitkin County, the second in importance, was favorably affected also by the latter cause.

The lead production of Utah fell off during 1905 chiefly because of the cave-in of the Ontario tunnel at Park City, in March, which stopped operations during nearly the whole of the remainder of the year. It put a stop for the time being to the development in depth of the Daly-West. The Silver King shipped heavily. Promising results have followed active developments in the Bonanza Flat section of the district. In the Stockton district the Honerine drain tunnel approached completion, in anticipation of which the principal mines confined themselves to preparatory work. In the Tintic district the Centennial-Eureka mine of the United States Mining Company was the heaviest shipper. At Alta the old Flagstaff mine is being opened, and the Columbus Consolidated has developed high-grade shipping ore.

The lead-smelting plant of the United States Company, with three furnaces at Bingham Junction, went into commission early in 1905, and an addition to it, practically doubling it, is being made. The company has also acquired the old Richmond and Eureka mines in Nevada and lead properties in Idaho, and has planned the building of a lead desilverizing and refining plant at East Chicago.

A number of isolated local smelting plants were built during 1905, among which are the Luna Lead Company, of Deming, N. Mex., which handles chiefly New Mexican and some Arizona ores, and the Arizona-Mexican Mining and Smelting Company, of Needles, Cal., which blew in in February, 1906. The company has its mines at Stockton Hill and Cerbat, Ariz., and Siam, Cal. The Mowry Mines Company, at Mowry, Ariz., started in December. At Sand Point, Idaho, the Panhandle Smelting Company (Limited) was building in 1905, and is expected to operate before the middle of the current year.

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, 1904, and 1905.

[Pounds.]

	1901.	1902.	1903.	1904.	1905.
In warehouse at beginning of year...	42,379,270	33,225,677	47,817,806	21,387,901	22,962,984
Direct importation	221,030,779	200,571,318	197,813,008	206,141,784	182,380,859
	263,410,049	233,796,995	245,630,814	227,529,685	205,343,843
Deduct in warehouse at end of year..	33,225,677	47,817,806	21,387,901	22,962,984	16,296,391
	230,184,372	185,979,189	224,242,913	204,566,701	189,047,452
Addition by liquidation...............	592,977	253,875	1,771,740	998,687	3,495,259
Total	230,777,349	186,233,064	226,014,653	205,565,388	192,542,711

The disposition of this was as follows:

Disposition of lead in warehouses in 1901, 1902, 1903, 1904, and 1905.

[Pounds.]

	1901.	1902.	1903.	1904.	1905.
Exported	194,199,419	157,834,807	163,774,605	167,181,377	117,263,861
Withdrawn for consumption	16,035,929	14,084,741	40,074,153	18,736,130	49,821,583
Deducted by liquidation	23,373,544	60,245,134	32,164,525	22,962,984	21,382,302
Total	233,608,892	232,164,682	236,013,283	208,880,491	188,467,746

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 1900:

Lead imported and entered for consumption in the United States, 1900–1905.

[Pounds.]

Year.	Ore and dross.		Pigs and bars.		Sheets, pipe, and shot.		Not otherwise specified.	Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.		
1900	10,209,742	$623,802	3,673,616	$76,141	27,945	$1,393	877	$702,213
1901	10,324,119	272,396	3,604,157	88,056	56,735	2,773	1,234	364,459
1902	14,499,339	316,005	12,443,615	319,035	224,209	7,765	5,258	648,063
1903	41,155,130	716,128	8,972,635	255,135	17,008	810	1,589	973,662
1904	19,015,540	328,279	17,334,033	480,823	69,581	2,441	5,277	816,820
1905	49,526,990	784,548	10,379,753	329,209	77,668	3,813	1,139	1,118,709

Lead, and manufactures of lead, of domestic production, exported, 1900–1905.

[Pounds.]

Year.	Manufactures of lead.		Pigs, bars, and old.		Total value.
	Quantity.	Value.	Quantity.	Value.	
1900	[a] 363,600	[b] $130,758	1,993,773	$88,664	$459,571
	....	[c] 240,149			
1901	[a] 490,460	[b] 178,752	4,787,107	214,842	624,534
	....	[c] 230,940			
1902	[a] 454,423	[b] 153,309	6,542,760	286,548	696,010
	....	[c] 256,153			
1903	[a] 364,220	[b] 127,530	112,544	6,210	491,362
	....	[c] 357,622			
1904	[a] 439,953	[b] 160,863	70,408	3,478	616,126
	....	[c] 451,785			
1905	[a] 445,002	[b] 156,162	125,332	5,623	667,861
	....	[c] 506,076			

[a] Type. [b] Value of type. [c] 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 1901 to 1905, inclusive, were as follows:

Sources of imports of lead.

[Pounds.]

Country.	1901.	1902.	1903.	1904.	1905.
United Kingdom	402,552	792,607	1,552,772	494,556	1,589,859
Germany	671,294	952,878	1,409,926	731,222	250,241
Other Europe	2,453	1,342,193	451,331	165,661	117,699
Total refined pig lead	1,076,299	3,087,678	3,414,029	1,391,439	1,957,799
British North America	52,130,002	19,464,937	19,200,806	17,903,798	16,362,916
Mexico	163,453,526	187,484,666	186,136,779	205,805,911	175,167,694
Total ore and base bullion	215,583,528	206,949,603	205,337,585	223,709,709	191,530,610
Other countries	8,282,502	5,195,174	4,061,872	602,164	3,266,999
Total imports	224,942,329	215,232,455	212,813,486	225,703,312	196,755,408

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 and 1905.

Estimate of the consumption of lead in the United States, 1901–1905.

[Short tons.]

	1901.	1902.	1903.	1904.	1905.
Supply—					
Total production desilverized lead	323,790	303,011	295,074	315,284	296,186
Soft lead	57,898	74,050	83,444	89,169	106,833
Imports, foreign refined	538	1,544	1,707	696	979
Stock, domestic, beginning of year	39,050	53,733	11,595	....	....
Stock, foreign, in bond, beginning of year[a]	21,190	16,613	23,909	10,694	11,481
Total supply	442,466	448,951	415,729	415,843	415,479
Deduct—					
Foreign base bullion and ores refined in bond and exported	97,100	76,962	90,353	79,596	54,295
Lead in manufactures exported under drawback	[a] 3,086	[a] 4,001	[a] 5,316	5,223	6,021
Stock, domestic, close of year	53,733	11,595	9,199	....	....
Stock, foreign, in bond[b]	16,613	23,909	10,694	11,481	8,148
Total	170,532	116,467	115,562	96,300	68,464
Apparent home consumption	271,934	332,484	300,167	319,543	347,015

[a] Fiscal years. [b] 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 1900:

Highest and lowest prices of lead at New York City, monthly, 1900–1905.

[Cents per pound.]

Year.	January.		February.		March.		April.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
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
1905	4.60	4.45	4.50	4.45	4.50	4.45	4.55	4.50

Year.	May.		June.		July.		August.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
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
1905	4.55	4.50	4.55	4.50	4.60	4.50	4.85	4.60

Year.	September.		October.		November.		December.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
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
1905	4.90	4.85	5.30	4.85	5.40	5.15	5.90	5.25

With the exception of a lowering in prices in January the lead market showed successive advances during the whole of the year, these becoming more pronounced during the closing months. There was virtually a famine of lead during the last quarter, so that very large premiums were paid for prompt delivery over the official prices named by the American Smelting and Refining Company. The price changes made by that interest were as follows: The year opened with lead at 4.60 cents, New York; on January 23 the price was made 4.45 cents, New York; on March 20, 4.50 cents; on July 26, 4.60 cents; August 24, 4.85 cents; November 1, 5.15 cents; on November 16, 5.25 cents; December 4, 5.35 cents, and December 21, 5.60 cents. Toward the end of October the outside price was 5.32½ cents, New York. It reached 5.40 cents early in November, and had risen to the equivalent of 5.90, New York, in the end of December. In that month several thousand tons of actual foreign lead were ordered for importation, the domestic market having absorbed the total domestic product and the usual quantity of exempt lead.

ZINC.

By Charles Kirchhoff.

PRODUCTION.

There was a fair increase in the production of spelter during the year 1905, the increase over 1904 being 17,147 short tons as compared with an increase of 27,483 tons in 1904. The production has more than doubled since 1897, when it closely approximated 100,000 tons, having been 99,980 tons.

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, 1873–1905.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1873	7,343	1893	78,832
1875	15,833	1894	75,328
1880	23,239	1895	89,686
1882	33,765	1896	81,499
1883	36,872	1897	99,980
1884	38,544	1898	115,399
1885	40,688	1899	129,051
1886	42,641	1900	123,886
1887	50,340	1901	140,822
1888	55,903	1902	156,927
1889	58,860	1903	159,219
1890	63,683	1904	186,702
1891	80,873	1905	203,849
1892	87,260		

In the different States the production has been as follows:

Production of spelter in the United States, by States, 1882–1905.

[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	[g]14,893	47,740	107,048	12,150	4,871	[h]186,702
1905	[g]24,513	46,606	114,287	11,844	6,599	203,849

[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 ZINC INDUSTRY.

The principal increase has taken place in the Eastern and Southern group, to which there was added in 1904 the new plant of the Graselli Chemical Company in West Virginia. In that year it was in operation only a part of the time. In 1905 the works had their first full year of operation. In Kansas no new plants were started in 1905, but those which started in 1904, the Caney Zinc Company, at Caney, which enlarged further to ten blocks in 1905, the Chanute Zinc Company, at Chanute, and the Cockerill Zinc Company, at Altoona, had a full year's production. The Granby Company made a larger product, having added a fifth block. Two Zellwegger mechanical roasting furnaces are building. The Prime Western and the Lanyon Zinc Company each added one block, and the United Zinc and Chemical Company is building two blocks and will follow with two more. Construction was started during 1905 on the works of Hegeler Brothers, at Danville, Ill., and by the Mineral Point Zinc Company, at Depue, Ill. The New Jersey Zinc Company, which has four furnaces at Palmerton, Pa., is enlarging with the ultimate object of producing with ten furnaces of the Convers-De Saulles type and two furnaces of the Siemens regenerative type.

A. B. Cockerill now controls plants at Gas, La Harpe, Altoona, and Pittsburg, Kans., and at Nevada and Rich Hill, Mo.

Zinc oxide.—The production of zinc oxide is estimated at 130,806,000 pounds, as compared with 119,226,262 pounds in 1904, and with 119,124,160 pounds in 1903. The Ozark Zinc Oxide Company is building a new plant at Coffeyville, Kans.

THE ZINC MINES.

The shipments of the Missouri-Kansas district during 1905 and previous years were as follows, according to records kept by local authorities:

Sales of zinc and lead ore in the Missouri-Kansas district in 1903, 1904, and 1905.

[Short tons.]

Camp.	Zinc ore.				Lead ore.			
	Quantity.			Value.	Quantity.			Value.
	1903.	1904.	1905.		1903.	1904.	1905.	
Webb City-Carterville	44,917	93,377	64,047	$2,877,855	9,880	16,508	16,699	$1,026,355
Joplin	63,870	72,428	70,481	3,404,980	8,084	8,732	6,291	388,040
Galena Empire	23,402	22,852	21,113	948,820	2,892	3,546	2,547	160,760
Alba and Neck City	9,454	16,997	18,048	864,985	153	157	174	10,740
Aurora	13,785	15,611	17,666	616,790	238	263	114	6,960
Granby	8,067	12,335	10,974	306,940	809	1,249	874	53,565
Carthage	6,453	8,218	5,704	272,485	199	124	11	620
Badger		6,394	8,892	421,400		88	53	2,960
Zincite	6,408	3,985	2,150	100,405	128	133	62	3,855
Mitchell		2,993	1,996	94,155		301	103	6,275
Duenweg	17,600	1,442	15,300	954,760	3,010	1,480	3,258	202,515
Spurgeon-Spring City	2,751	1,980	2,723	89,165	916	550	142	8,790
Carl Junction	5,592	1,725	62	3,100	11	81		
Beef Branch		1,185	1,635	37,665		818	335	18,940
Central City	2,813	1,171	1,167	51,850	263	157	9	550
Cave Springs	2,410	902	63	2,700	295	129		
Reeds		1,015	694	31,040		6		
Diamond		951	425	19,665		12		
Baxter Springs		633	2,670	103,480		150	566	34,450
Stotts City	338	210	579	33,325		16	88	660
Prosperity	5,720				735			
Oronogo	7,507		6,831	322,230	221		319	19,850
Miscellaneous	6,602	389	673	27,175	696	30	14	800
Total, 1905			253,893	11,584,970			31,659	1,946,685
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

Cold weather in January, February, and March, floods in July and August, and heavy rains in October cut down considerably the tonnage of ores produced in the Joplin district, whose capacity, under normal conditions, is considerably greater.

There has been a good deal of activity during 1905 in the Platteville district in southwestern Wisconsin, and a considerable increase in the production has taken place. This is, however, merely the forerunner of further expansion, important interests having entered the field. There has been a good deal of prospecting and of development and great activity in the building of concentrating plants. The blende concentrates contain considerable marcasite. The system of roasting and subsequent magnetic separation has made it possible to produce a concentrate high in zinc and low in iron, which is readily marketable. The probabilities are that the district will assume increasing importance as a source of supply for the zinc smelters.

The product of the Franklin mine of the New Jersey Zinc Company is reputed to have been 361,829 tons in 1905, as compared with 280,029 tons in 1904.

In Virginia the old Wythe property was the only producer. The low grade ores and tailings are now being used to produce oxide, which is converted into spelter. The Albemarle Zinc and Lead Company, at Fabers, has completed a concentrating mill, and the Cedar Springs Zinc Mining and Development Company, at Rural Retreat, contemplates the erection of a plant.

In Colorado the largest zinc ore tonnage comes from Leadville, the principal shippers equipped with concentrating plants being the Western Mining Company, the Moyer, and the Yak tunnel. The Creede district also markets zinc ores, and some tonnage comes from Clear Creek and Summit counties.

The zinc ore product of the Park City district in Utah fell off heavily through the caving in of the Ontario drain tunnel, which caused the stoppage of operations of the Daly West Mining Company. A mill equipped with the Blake-Morscher electrostatic separators was put into commission during 1905 at Salt Lake City. At Frisco the Horn Silver Company shipped a considerable tonnage of zinc ore to the Iola works. There has been some discussion of building a zinc works at Bonneville, 12 miles north of Ogden.

In Idaho the Wood River district has produced several thousand tons of zinc ore. From the Coeur d'Alene a small quantity of hand-sorted blende has been marketed, and the Success Company has started a concentrator which will recover the blende in the mixed lead and zinc ores of the Granite mine.

A very considerable output of zinc carbonate has been obtained from the Graphic and Kelly mines in the Magdalena district, New Mexico. It is chiefly used for the manufacture of oxide. Smaller quantities have come from the Hanover district.

In the Butte district in Montana the Montana Zinc Company has worked the lead-zinc ores of the Lexington mine and has made some shipments of concentrates. Zinc concentrates are also to be produced from the Comet mine near Corbin.

Among the foreign sources of supply of zinc ore are Canada and Mexico. It is the Slocan district in British Columbia which supplies the greater part of the former. During 1905 concentrating plants were started at Kasco, Rosebery, and Pilot Bay, the production of British Columbia being returned at 9,413 tons. A zinc smelting plant is under course of erection at Frank, in Alberta, which will divert some of the ore.

Considerable quantities of calamine are being shipped from Monterey, from mines formerly worked for lead, to Kansas smelters, while mixed sulphides have been imported into Pueblo from the Conchos River district, east of Chihuahua, which has been opened up by the Kansas City, Mexico and Orient Railway.

IMPORTS AND EXPORTS.

The imports of zinc in its different forms have ceased to be of any consequence. For the years 1901–1905 they were as follows:

Zinc imported and entered for consumption in the United States, 1901–1905.

[Short tons.]

Year.	Block or pigs.		Sheets.		Old.		Value of manufactures.	Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity	Value.		
1901	278	$22,766	79	$10,467	75	$3,277	$39,549	$76,059
1902	448	36,536	68	8,339	157	8,299	32,708	85,882
1903	202	19,161	129	8,537	163	11,772	10,376	49,846
1904	341	34,211	17	2,230	36	3,247	10,394	50,082
1905	428	46,295	14	1,953	86	5,110	8,253	61,611

Zinc ores, including calamine, valued at $315,041, are reported by the Bureau of Statistics as imported in 1905.

Imports of zinc oxide, 1900–1905.

[Short tons.]

Year.	Dry.	In oil.	Year.	Dry.	In oil.
1900	1,309	38,706	1903	1,744	166,034
1901	1,860	128,198	1904	1,293	224,244
1902	1,636	163,081	1905	1,718	342,944

Exports of zinc and zinc ore of domestic production, 1901–1905.

[Short tons.]

Year.	Ore or oxide.		Plates, sheets, pigs, or bars.		Value of manufactures.	Total value.
	Quantity.	Value.	Quantity.	Value.		
1901	44,156	$1,167,684	3,390	$288,906	$82,046	$1,538,636
1902	55,733	1,449,104	3,237	300,557	114,197	1,863,858
1903	39,411	987,000	1,521	163,379	71,354	1,221,733
1904	35,911	905,782	10,147	1,094,490	117,957	2,118,229
1905	30,946	848,451	5,516	682,254	159,995	1,690,700

CONSUMPTION.

For the first time in the history of the zinc industry the consumption of spelter crossed the 200,000-ton mark, as is shown in the following table:

Estimated consumption of spelter, 1898–1905.

[Short tons.]

	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
Production	115,399	129,051	123,886	140,822	156,927	159,219	186,702	203,849
Imports	1,303	1,392	961	357	448	202	341	521
Add decrease of stock during year	2,014	897		3,908			4,017	1,603
Total supply	118,716	131,340	124,847	145,087	157,375	159,421	191,060	205,973
Deduct—								
Exports of foreign	18		23				2	19
Exports of domestic	10,499	6,755	22,410	3,390	3,237	1,521	10,147	5,516
Increase of stock during year			3,015		1,456	3,519		
Total	10,517	6,755	25,448	3,390	4,693	5,040	10,149	5,535
Apparent home consumption	108,199	124,585	99,399	141,697	152,682	154,381	180,911	200,438

For the first time the Bureau of Statistics has reported separately the exports of zinc dross. These amounted to 5,318 short tons from July 1 to December 31, inclusive, in 1905.

THE ZINC MARKET.

Like all the metals, spelter enjoyed the advantages of greatly stimulated consumption during 1905, with prices at a fair level. The year started with prices ranging between 6.10 and 6.15, New York, and developed a slightly easing tendency during January in spite of high prices for ore at Joplin. The market remained steady during February under a moderate business. Active inquiry from consumers caused an upward movement early in March coincident with a sharp decline in the price of ore, which reacted upon the metal toward the end of the month, and carried the value to 5.87½ cents, New York. A dull month in April witnessed a temporary reaction to 6 cents, but May brought increasing eagerness to sell at concessions for forward delivery, and the market fell off to 5.40 cents, New York. Even lower figures were reached early in June, coincident with a decline in the price of ore in Joplin to $43.50 per ton, as compared with $58, early in January. There was a moderate strengthening toward the middle of June, but the market grew dull again. Floods in the Joplin district in July, heavily curtailing the ore supply, caused an advance in the price of the metal to 5.60 cents, and early in August to 5.70 cents and to 5.80 cents. There came a slight reaction, gradual stiffening in September and greater activity, which caused the market to advance to 5.95 cents, New York, at the end of the month. Continued good inquiry and the sale of several thousand tons of spelter for export, made possible by scarcity and high prices abroad, kept the metal above the 6-cent mark during October. The price was 6.10 cents early in November, but the market rallied, and during December gathered strength rapidly, under heavy buying, until at the close of the year 6.62½ cents, New York, was reached.

The following table shows the prices of spelter for the last five years:

Price of common Western spelter in New York City, 1901–1905, by months.

[Cents per pound.]

Year.	January.		February.		March.		April.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
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
1905	6.20	6.10	6.15	6.10	6.15	5.87	6.00	5.75

Year.	May.		June.		July.		August.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
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
1905	5.70	5.40	5.35	5.25	5.60	5.25	5.80	5.60

Year.	September.		October.		November.		December.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
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
1905	5.95	5.75	6.15	6	6.25	6.10	6 60	6.40

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, 1903–1905.

[Short tons.]

Country.	1903.	1904.	1905.
Belgium	144,480	154,314	160,345
Rhine district	68,673	72,083	74,127
Holland	12,897	14,442	15,176
Great Britain	48,625	50,949	56,140
France and Spain	46,794	54,107	55,524
Silesia	130,855	138,538	143,243
Austria and Italy	10,108	10,192	10,315
Poland	10,914	11,693	8,422
Total Europe	473,346	506,318	523,292
United States	159,218	186,704	203,849
Total world's production	632,564	693,022	727,141
United States' percentage of world's production	26.0	26.9	28.0

The largest producer in the world is the Vieille Montagne Company, with an output in 1905 of 70,454 short tons; Hohenlohe follows, with 34,630 tons, and the New Jersey Zinc Company with its affiliated and controlled companies, is third with 34,459 tons. The Schlessische Company produced 32,403 tons, the Edgar Zinc Company of the United States Steel Corporation, 29,779 tons, and G. von Giesche's Erben 29,378 tons. American producers, therefore, occupy third and fifth places, and the United States makes 28 per cent of the total product of the world.

ZINC AND LEAD ORES IN 1905.

By H. Foster Bain.

GENERAL CONDITIONS.

In the Contributions to Economic Geology, 1904,[a] the writer gave a general account of the zinc and lead resources and production of the United States. It is proposed here to present certain facts which have since been developed, and to record the main advances made in the development, particularly of the zinc resources, in 1905. The market for both zinc and lead ores has been excellent, and the search for new deposits has been very actively carried on. In the lead industry attention was concentrated during 1905 rather on the smelting of ores than on the development of new districts. Various forms of "lime roasting" have been introduced and much discussed in the technical press, and other improvements have come forward. Production continues to be mainly centered in the Coeur d'Alene district, Idaho, and in Missouri, Colorado, and Utah. The active search for zinc has increased the output steadily in all the zinc-lead districts described later; and in the zinc free districts, southeastern Missouri, and the Coeur d'Alene, there was a corresponding activity.

The production of the different districts is sufficiently indicated by the statistics collected by Mr. Kirchoff.[b]

The geology of the Coeur d'Alene region was discussed by F. L. Ransome in the Contributions to Economic Geology, 1904,[c] and again in the Mining Magazine.[d]

The mining conditions have been discussed by Stanley A. Easton.[e]

The soft-lead resources of the United States have been briefly noted by the writer.[f]

The southeastern Missouri district has been especially discussed by H. A. Wheeler[g] and D. O. Johnson.[h]

The character of the ore in the southwestern district has been studied by Petraeus and Waring.[i]

The Bingham Canyon district in Utah has been fully discussed by J. M. Boutwell,[j] and a similar report on the Park City district is in press.[k]

The Leadville district has been briefly discussed by A. W. Warwick.[l]

Other papers of interest in this connection are cited in the discussion of the zinc districts.

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[a] Bull. U. S. Geol. Survey, No. 260, 1905, pp. 251-273.

[b] See papers on Lead and Zinc, pp. .

[c] Ransome, F. L., Ore deposits of the Coeur d'Alene district, Idaho: Bull. U. S. Geol. Survey, No. 260, 1905, pp. 274-303.

[d] Ransome, F. L., The Coeur d'Alene district, Min. Mag., vol. 12, pp. 26-32.

[e] The Coeur d'Alene in 1905: Eng. and Min. Jour., vol. 81, 1906, p. 11.

[f] Bain, H. Foster, Soft-lead resources of the United States: Min. Mag., vol. 12, 1905, pp. 18-25.

[g] The southeast Missouri lead district: Eng. and Min. Jour., vol. 81, 1906, pp. 11-12.

[h] Lead mining in southeastern Missouri: Eng. and Min. Jour., vol. 80, 1905, pp. 481-482.

[i] Petraeus, C. V., and Waring, W. G. The lead ores of southwestern Missouri: Eng. and Min. Jour., vol. 80, 1905, p. 721.

[j] Boutwell, J. M., Economic geology of the Bingham mining district: Prof. Paper, U. S. Geol. Survey, No. 38, 1905, pages 413.

[k] Prof. Paper, U. S. Geol. Survey (in preparation).

[l] Warwick, A. W., The Leadville district: Min. Mag., vol. 11, 1905, pp. 430-439.

CONDITIONS BY DISTRICTS.

INTRODUCTION.

Zinc is marketed mainly as spelter, though some ore is converted directly to oxide. The principal countries producing spelter are Germany, the United States, and Belgium. Great Britain, France, and Holland produce smaller but still important quantities. Zinc ores come most largely from Germany and the United States, though there is an important production from Spain, Italy, and Australia, and a small production from France, Sweden, Algeria, Great Britain, and other countries. The most important changes in the ore situation of recent years have been the rapid growth of production in the United States and Australia, and the stationary or declining output of European countries. Australia is becoming a principal producer. Mexico and Canada are now regularly shipping ore, the former in considerable quantities. Canada has also become a smelting country, and is likely in the future to ship metal rather than ore.

In the United States the zinc ore production is from three regions: (1) The Eastern States, (2) the Mississippi Valley, (3) the Rocky Mountain region. The statistics of spelter production collected by Mr. Kirchoff give a partial view of the relative importance of these areas. In the Eastern States, however, a very considerable quantity of ore is burned to form oxide, and a certain portion is exported. In the Mississippi Valley oxide is also made; occasionally a little ore is exported; and, of recent years, a great deal of Rocky Mountain ore is smelted. In the Rocky Mountain States some ore is made into oxide and a little is reduced to spelter, but the bulk is shipped either to the Mississippi Valley or to Europe. Separate statistics of ore production are therefore desirable, though as yet complete figures are not available.

EASTERN STATES.

New Jersey.—The great bulk of the eastern zinc ore comes from the Franklin Furnace property, New Jersey, and is produced by the New Jersey Zinc Company. This well-known deposit is unique in its size and mineralogic character. The ore consists of franklinite, willemite, and calcite, with minor quantities of zincite and various silicates. It is milled by jigging followed by magnetic concentration, and is used for the manufacture of oxide and high-grade spelter, with spiegeleisen and lithophone as by-products. In 1905 the production is reported by State Geologist Kümmell to have been 361,829 short tons. The average zinc content is estimated at approximately 23 per cent. These deposits have recently been studied for the United States Geological Survey by Mr. Arthur C. Spencer, and a report upon them is now in preparation.

Northern Appalachians.—At numerous points in the belt of pre-Cambrian and early paleozoic rocks, stretching from New York to Alabama, zinc is known to occur. In the Northern States it has been mined near Ellensville, N. Y., Bethlehem, Pa., and at various other points. Recently mining has been begun near Edwards in St. Lawrence County, N. Y. The occurrence here is described by Assistant State Geologist Newland.[a] The ore, which consists of blende with minor quantities of galena and pyrite, occurs in a pre-Cambrian limestone, which is associated with gneiss. At one point a band of blende, 5 to 6 feet thick, has been uncovered and followed to a depth of 15 feet. About 3,000 tons have been taken out, and grades ranging in zinc content up to 48 per cent have been produced. No shipments have yet been made. Attempts are also to be made to reopen the neighboring Balmat mine.

Virginia-Tennessee.—In the southern Appalachians active development is confined to southwestern Virginia and East Tennessee. This area was visited by the writer in May, 1905, with Dr. T. L. Watson, State geologist of Virginia, who has since

[a] Newland, D. H., Zinc Ore in northern New York: Eng. and Min. Jour., vol. 81, 1906, p. 1094.

described the deposits and mining conditions in detail.[a] The center of spelter production is at Pulaski, Va., where the Bertha furnaces make a well-known high grade metal. These furnaces are run at present principally on willemite shipped down from New Jersey, though small quantities of local ores, of zinc dust from the iron furnaces of the valley, and of zinc oxide made from tailings of the old Bertha mine are used. The large deposits of calamine, which for many years formed the basis of the local zinc industry, are practically worked out, and attention is now concentrated upon the development of sulphide ores. The largest measure of success in this particular has been achieved at Wytheville, where in the famous old lead mine two important shoots of blende have been developed. Near Cedar Valley, a few miles to the west, good surface showings of a rare, lemon-colored blende of unusual purity have been found. The ore bodies have not been followed down, and their extent is not really known. Near Mascot, Tenn., the Roseberry Zinc Company has been drilling for some time, and is now developing an important body of ore. At Straight Creek, the Tennessee Zinc Company, of Cincinnati, Ohio, have taken hold of the old mines and are sinking on the large ore shoot formerly mined. The ore body is of good size and excellent grade.

At various other points in this region zinc and lead occur, and prospecting is being carried on.[b] Although the production is at present unimportant, it may be expected to increase; and for an indefinite period more or less ore will be mined.

MISSISSIPPI VALLEY.

Ozark region.—The principal zinc-producing district of the Mississippi Valley is the Missouri-Kansas, or, as it is familiarly called, the Joplin district. According to the Lead and Zinc News,[c] the total ore production of the district for 1905 was 258,894 tons, a slight decrease from that of 1904. This ore may be figured at an average zinc content of 58 per cent. To this total should be added approximately 12,000 tons for the production of central and southeastern Missouri, north Arkansas, and scattered points in the Ozark region. The zinc ores of the Ozark region, as is well known, are remarkable for their freedom from iron and for the high grade of concentrates produced. They are in great demand, and the Joplin basis fixes the price for ore throughout the Mississippi Valley. The most significant features of the year in the Missouri-Kansas district were the introduction of natural gas for power at the mines, the extended use of electricity from a central power station, the active development of the great sheet deposits of the Webb City-Cartersville area, and the rapid extension of the mining area along the western border of the district near Baxter Springs and Peacock.

The genesis and structural relations of these ores have attracted recent attention and have been discussed by Siebenthal[d] and by Buckley and Buehler.[e]

Recent geological studies indicate that there has been less vertical movement along fault planes in the area than has been thought, and that the deep pre-Pennsylvanian erosion channels were of major importance in the localization of the ore bodies. Siebenthal holds that the minor faulting localized by the channels is still significant in the genesis of the ores. Buckley and Buehler, on the other hand, would make the whole process of concentration one of the action of local, downward-moving waters. A fuller report upon the district by Siebenthal and W. S. T. Smith is in preparation.

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[a] Watson, T. L., Lead and zinc deposits in Virginia: Geol. Survey Virginia, Geol. ser., Bull. No. 1, 1905, 156 pages; Lead and zinc deposits of the Virginia-Tennessee region: Bimonthly Bull. Am. Inst. Min. Eng., No. 8, pp. 139-195.

[b] Eng. and Min. Jour., vol. 80, 1905, pp. 311-312.

[c] Missouri-Kansas in 1905: Lead and Zinc News, vol. 9, No. 10, January, 1906.

[d] Siebenthal, C. E., Structural features of the Joplin district: Econ. Geology, vol. 1, 1905, pp. 119-128. Discussion by H. F. Bain, p. 172.

[e] Buckley, E. R., and Buehler, H. A., Geology of the Granby area: Missouri Bureau of Geol. and Mines, vol. 4, 2d ser., 1906, 120 pages.

Van Horn[a] has described the geology of a central Missouri area in which lead and zinc occur. The north Arkansas deposits have continued to attract attention, and the area is being slowly developed.[b]

The ores of the Ozark region are almost entirely reduced to spelter, and the smelting plants are mainly located in the natural-gas region of eastern Kansas. Below is given a list of the Kansas plants operating in 1905:

List of Kansas zinc smelters.

	Location.		Location.
Chanute Zinc Company	Chanute.	Lanyon Zinc Company	La Harpe.
Edgar Zinc Company	Cherryvale.	Granby Mining and Smelting Company	Neodesha.
Caney Zinc Company	Caney.	Cherokee Zinc Company	Gas.
United Zinc and Chemical Company	Iola.	Altoona Zinc Company	Altoona.
Prime Western Spelter Company	Gas.	La Harpe Zinc Company	La Harpe.
Prime Western Spelter Company	Iola.	Pittsburg Zinc Company	Pittsburg.
Lanyon Zinc Company	Iola.	Cockerill Zinc Company	Pittsburg.

An interesting feature of the year was the firing up of the old coal smelters at Pittsburg, Kans., as also at Rich Hill and Nevada, Mo. In addition to these plants the Glendale and the Sandoval draw much of their ore from the Ozark mines, and important quantities go to the smelters of northern Illinois. The Indiana smelters are no longer in operation. In preparing the Joplin ore for the market simple jigging is necessary, though table concentration for the fine sizes is being rapidly introduced, and a small quantity of ore which occurs intimately mixed with pyrite undergoes re-treatment and magnetic separation. The great purity of the ore and the ease of preparation give the district a dominant position in the ore market.

Kentucky districts.—There are two districts in Kentucky in which zinc and lead occur. That lying in the western part of the State is now producing small quantities of ore in connection with the mining of fluorspar. Ulrich and Smith[c] have published a full account of it within the year, and the State survey is now engaged in making detailed maps. In central Kentucky, near Lexington, there is also an area in which lead and zinc ore occur, though very little has been produced. This area is described in a bulletin of the new Kentucky geological survey.[d]

Upper Mississippi Valley mines.—The second most important district in the Mississippi Valley is that occupying southwestern Wisconsin and adjacent portions of Illinois and Iowa. This, which is an old lead region, has recently attracted much attention and is being very rapidly developed. Since the beginning of the mining in the eighteenth century approximately $50,000,000 worth of lead has been produced in this area, and perhaps one-fifth as much zinc. Since 1860 very little mining has been done, until in the last five years. The old lead miners outlined the district and discovered most of the ore bodies. Present activities are largely confined to mining the zinc ore found quite uniformly below the lead. The workings are shallow, ranging usually from 150 to 200 feet in depth; the ore bodies large and fairly regular, and the mining conditions favorable. The district has been slow in development because of the peculiar character of the ore, which is an intimate mixture of blende and marcasite with smaller quantities of galena, in a gangue of calcite and dolomite. Near water level there are considerable bodies of zinc carbonate. The latter has been in demand for several years for the manufacture of zinc oxide, but the blende has only recently been salable in any large way. Ordinary jigging produces a good lead product and a large quantity of mixed zinc-iron concentrates. An average

[a] Van Horn, F. B., Geology of Moniteau County: Missouri Bureau Geol. and Mines, vol. 3, 2d ser., 100 pages.

[b] Waring, Frank, Review of north Arkansas district: Lead and Zinc News, vol. 10, No. 1, 1906, pp. 7–9; New development in the Arkansas field, ibid., No. 8, 1906, p. 9.

[c] Ulrich, E. O., and Smith, W. S. T., The lead, zinc, and fluorspar deposits of western Kentucky: U. S. Geol. Survey Prof. Paper No. 36, 1905, 218 pages.

[d] Miller, A. M., Lead and zinc bearing rocks of central Kentucky: Kentucky Geol. Survey Bull. No. 2, 35 pages.

analysis of this material shows 35.3 per cent zinc, 18.35 per cent iron, and 0.37 per cent lead. Such material can not be used in the ordinary smelting plants of the Mississippi Valley. The condition has been met in three ways.

At the works of the Mineral Point Zinc Company, Mineral Point, Wis., an acid plant has been installed, and the fumes from the roasted ore are converted, by the contact process, into high-grade sulphuric acid, leaving the iron and zinc in the form of oxides on the hearths. These are then burned in the oxide furnaces, the zinc being caught in the bags and the iron ore left on the grates. The objections to this process are the cost of the plant, the difficulties involved in roasting mixed sulphides, and the fact that freight on bulky, low-grade material must be paid from the mines to the acid plant. There is the further difficulty, if the problem be considered in a large way, that if all the ore were so treated new markets would need to be found for the acid.

The second method, and the one most commonly employed, is to roast the ore at or near the mines and then remove the iron by magnets. Since the blende itself is practically free from iron, it becomes possible in this way to produce a reasonably high-grade concentrate. Such concentrates, produced from the ore, of which analysis was given above, ran 57.2 per cent zinc, 4.50 per cent iron, and 0.58 per cent lead. It is possible occasionally to reduce the iron content to 3 or even 2 per cent, and to run the zinc up to 60 per cent. The limitations of the process are those of mechanical detail and cost of operation rather than any involved in an iron content of the blende. This method of treatment is usually carried on at the mine in a small plant supplementary to the ordinary concentrating mill. Only one central plant for re-treatment has yet been built and operated, that of the Joplin Separating Company at Galena, Ill. The objections to this method of treatment are mainly in the loss of zinc and of the sulphur in the marcasite. Since there is a local market of $3 to $4 per ton for sulphur, this is a direct loss. The cost of the additional plant, while not large, is none the less an important item in the case of the smaller zinc mines.

The third method of treatment tried is electrostatic concentration. A plant for this work was in operation for some time at the Empress mine at Benton. The Blake machines were used, and some excellent concentrates were made. This process has the advantage of producing a clean marcasite product as well as a blende concentrate. Because of the technical character of the work and the lack of general knowledge regarding static electricity, it seems better fitted for central re-treatment plants or for large operations than for individual mines.

The geology and mining conditions of the area have been much discussed in the last year. Aside from the papers in the Contributions to Economic Geology, 1904,[a] the Survey has recently published a special report upon the Illinois portion of the field,[b] and has in print a general discussion of the region [c] and a folio [d] covering the Wisconsin portion of the region. The Wisconsin Geological and Natural History Survey has published a number of large scale detailed maps of the principal districts,[e] with a brief descriptive text. A number of briefer articles have appeared in technical journals. A few of them are listed in the footnote.[f] The output of the Wisconsin district is not usually reported separately. In 1904 the writer estimated the

[a] Bain, H. F., Lead and zinc resources of the United States: Bull. U. S. Geol. Survey, No. 260, 1905, pp. 251–273; Grant, U. S., Zinc and lead deposits of southwestern Wisconsin; op. cit., pp. 304–310; Ellis, E. E., Zinc and lead mines near Dodgeville, Wis.; op. cit., pp. 311–315.

[b] Bain, H. F., Zinc and lead deposits of northwestern Illinois: Bull. U. S. Geol. Survey, No. 246, 1905, 56 pages.

[c] Bain, H. F., Zinc and lead deposits of the upper Mississippi Valley: Bull. U. S. Geol. Survey, No. 294, 1906. (In press.)

[d] Grant, U. S., and Burchard, E. F., Lancaster-Mineral Point Folio: Folio, U. S. Geol. Survey, 1906. (In preparation.)

[e] Grant, U. S., Report on the lead and zinc deposits of Wisconsin, with an atlas of detailed maps: Wisconsin Geol. and Nat. Hist. Survey, Bull. 14, 1906, 100 pages.

[f] Grant, U. S., Structural relations of the Wisconsin lead and zinc deposits: Econ. Geology, vol. 1, 1905–6, pp. 233–242; discussion, by A. H. Purdue, p. 391. Brooks, George S., milling in southwestern Wisconsin: Eng. and Min. Jour., vol. 81, 1906, pp. 1140–1142. Staff correspondence, Eng. and Min. Jour., vol. 81, 1906, p. 1183 et seq. Hedburg, E., Wisconsin zinc fields: Mining World, vol. 24, 1906, pp. 61–62; ibid., pp. 174–175. Davis, Ralph E., Mississippi Valley lead and zinc district: Mining World, vol. 24, 1906, pp. 548–549.

tonnage at 19,300 tons, which proved afterwards to be a little too low. For 1905 the output of the three States may be estimated at about 33,000 tons. The bulk of the ore is treated at Mineral Point, Wis., and at the northern Illinois zinc smelters, at La Salle and Peru. Ore is also shipped to Waukegan and to Sandoval, in southern Illinois, as well as to Charleston, W. Va., where the Graselli Chemical Company uses low-grade material. New works are now being built at De Pue and Danville, Ill., which will draw on this field as well as on the Joplin district.

ROCKY MOUNTAIN REGION.

General conditions.—Conditions of zinc-ore mining and treatment in the Rocky Mountain region are radically different from those in the districts already discussed. The ores are much more complex; they contain gold and silver values; the usual ore bodies are entirely different in form and probably in genesis; and the mining, milling, and smelting methods are peculiar. Although zinc has been known in the West for many years, the many difficulties in its production have prevented its being mined in quantity until the last few years. When, however, the demand for spelter began to grow faster than the output of the Mississippi Valley mines, serious attempts began to be made to use the western ores. These attempts were so successful that they are already largely past the experimental stage, and the output is large and growing. The principal zinc-ore producing States of the West are, in order, Colorado, New Mexico, Utah, Montana, and Idaho. It is a striking peculiarity of the distribution of these ores that so far they have not been found in quantity in the Pacific States, and that the production from the Great Basin has been small. The zinc ores of the West are, so far as present knowledge goes, mainly confined to the Rocky Mountain region.

Character of the ore.—The New Mexico production is largely of carbonate ore which goes into the manufacture of zinc oxide. Aside from this, the zinc ore of the West is almost wholly sulphide, either ferruginous or iron free. It is customary to speak of the latter as "rosin blende" to distinguish it, and it is produced mainly at Creede, Colo. In general the western zinc sulphide, even when free from all mechanically intermixed pyrites, carries an important quantity of iron which seems to be chemically combined with the blende. The mineral is really a marmatite, as is shown by the following analyses of selected specimens of typical Colorado ores. These analyses were made by Mr. A. W. Warwick, of Denver, and are published by his courtesy. The Adams, Col. Sellars, and Yak ores are from Leadville.

Analyses of Colorado zinc ores.

[A. W. Warwick, analyst.]

	Adams.	Col. Sellars.	Yak.	Kokomo.
Zinc[a]	52.8	47.6	45.1	55.2
Sulphur	34.7	35.7	36.4	33.6
Iron[b]	12.1	14.8	17.8	10.9
SiO_2	.2	.4	.2	.26
	99.8	98.5	99.5	99.9

[a] Includes cadmium, which varied from 0.1 to 0.35 per cent.
[b] Includes manganese, which varied from 1.3 to 3.7 per cent.

Ratio of ZnS to FeS.

(1) 3 ZnS to 1 FeS.

(2) 2 ZnS to 1 FeS.

(3) 2 ZnS to 1 FeS.

(4) 4 ZnS to 1 FeS.

Sp. gr. 3.85–3.91. Luster, steel-blue to dull steel. Streak, reddish-brown; entirely soluble in dilute hydrochloric acid.

A special study was also made by Mr. Warwick of the concentrates of the Adams mill at Leadville. This is of interest as showing the constitution of the ordinary ore concentrated in a wet mill.

Analysis of concentrates from the Adams mill, Leadville, Colo.

[A. W. Warwick, analyst.]

Zinc	45.76
Iron (sol. in HCl)	4.80
Iron (insol. in HCl)	6.60
Sulphur	32.95
Silica	4.20
Manganese	3.76
Lead	Not determined.
	98.07

The separation of the mineral marmatite (3 ZnS 1 FeS) from the pyrite (FeS_2) was made with hydrochloric acid, and the composition of the concentrates was determined to be as follows:

Marmatite	81.92
Pyrite (FeS_2)	13.83
Silica (SiO_2)	4.20
	99.95

Such complex ores as these require especial treatment in milling and smelting, particularly where, as is commonly true, they carry values in gold and silver. Two general methods have been adopted: (1) Treatment of crude ore or wet concentrates in centrally located remilling plants; (2) treatment in specially designed smelting plants.

Milling methods.—The first method is most common and such mills are now in active operation at Canyon, Denver, and Leadville, Colo., at Butte, Mont., and at Salt Lake City, Utah. In addition, there are a few mills such as the Wilfly, at Kokomo, Colo., which supplement their own wet concentration by some form of magnetic separation. The re-treatment mills include always some device for magnetic or electrostatic separation of the ore, either in combination with the ordinary wet process or alone. Since the blende here carries an important quantity of iron the separation is effected on unroasted ore. The most common machine is the well known Wetherill magnetic separator, which has been frequently described. The International or Snyder machine is in use at Leadville and in British Columbia. Other types are being experimented with. The Wetherill machines have the advantage of low operating and repair charges. Their capacity is, however, small, their first cost high, and all material must be finely crushed, evenly sized, and entirely dry before being treated. To what extent the other types of machines will overcome these drawbacks is uncertain since they seem to be largely inherent.

Electrostatic separation has recently attracted considerable attention. The machine most largely used is the Blake-Morsher, the patents on which are now controlled by the Lanyon Zinc Company. It has been frequently described.[a] It depends in operation primarily upon differences in electro-conductivity of mineral particles, but in later types takes advantage also of differences in electrostatic capacity. It has also proved possible by coating mineral particles, as with copper sulphate solution, to act on otherwise inert material. The machines seem to be past the experimental stage and are now used in practical everyday work, but there are many difficulties yet to be overcome. As in the use of the magnetic machines, the ore must be finely crushed, evenly sized, carefully spread, and perfectly dry. There are also difficulties due to the imperfect control of the static current, and in its generation, though generating machines have lately been very much improved.

[a] Blake, Lucien I., Electrostatic concentration: Eng. and Min. Jour., vol. 79, p. 1036; ibid., vol. 80, 1905, p. 34.

The Sutton-Steel dielectric separator, which has been experimented on at El Paso, depends in its action upon the electric susceptibility of the different minerals. Tests described by R. C. Canby[a] were very favorable, but the machine has not yet come into commercial use.

The Wetherill machine is used in the Empire mill at Canyon, the Colorado Zinc Company's mill at Denver, the Wilfly mill at Kokomo, and at one or two small mills in the San Juan. The Blake-Morsher machine is used in the mill of the Colorado Zinc Company at Denver, the Western Ore Separating Company at Salt Lake City, and the Montana Zinc Company at Butte. The International machine is used in the mill of the American Zinc Extraction Company at the mouth of the Yak tunnel in Leadville. A plant with German machines had been recently installed at the smelter of the United States Zinc Company at Pueblo, and was being tested when visited. The attempt was being made to treat wet material.

The ore going to the re-treatment mills runs generally 25 to 35 per cent in zinc, 8 to 10 ounces of silver, and up to 10 per cent in lead. Below this grade it is usually profitable to treat the ore in local wet concentration mills, while ore grading above it can ordinarily be smelted direct. These re-treatment plants aim especially to raise the grade of the zinc ore by separating it from the iron and lead. Silica is generally eliminated by wet concentration. The plants produce concentrates running from 42 to 48 per cent in zinc and occasionally higher. Such concentrates can be treated in ordinary zinc smelters, and when they carry any considerable amount of lead, silver, and gold the retort residues are sold to the American Smelting and Refining Company. Generally, however, the bulk of the gold-silver values goes into the lead-iron product made in milling and is smelted direct.

The concentrates from each re-treatment mill go mainly to some affiliated smelting plant. The product from the Rho mill (American Zinc Extraction Company) at Leadville goes to the United Zinc and Chemical Company, at Iola. The product of the Western Ore Separating Company, at Salt Lake City, which is owned by the Lanyon Zinc Company, goes to the latter's smelters at Iola and La Harpe, as does also the main output of the Colorado Zinc Company and the Montana Zinc Company, with which the Lanyon Company has contracts. The Empire mill, at Canyon, is affiliated with the Mineral Point Zinc Company and with certain eastern Kansas smelters belonging to the New Jersey Zinc Company.

Smelting methods.—A considerable quantity of western ore goes direct to smelting plants which are prepared to handle it by certain unusual methods. These are the Mineral Point, Wis., plant, already mentioned; the United States Zinc Company, at Pueblo; the United States Smelting Company, at Canyon, Colo.; and the American Zinc and Chemical Company, at Denver. The Ozark Oxide Company, at Joplin, Mo., and Coffeyville, Kans., handles carbonate ores from New Mexico in a manner somewhat like that adopted at Canyon, and a number of the ordinary zinc smelters handle the western ores after passing through the re-treatment mills, as well as some special lots of crude ore. This they accomplish mainly by mixing with purer ores, so as to bring down the percentage of iron in the retort charge to below the danger point. The smelting plants noted above vary so much in method and equipment that each must be described separately.

The American Zinc and Chemical Company, at Denver, operated up to the fall of 1905 a small plant operating under the Dewey patents. This had the distinction of having used very low grade ores—as low as 20 per cent zinc, 5 per cent lead, and 8 ounces of silver. The process consisted in obtaining a solution of zinc in the form of sulphate, evaporating the sulphate to dryness and calcining it for the production of oxide. The plant was small and the operations somewhat experimental. It is understood that it is to be rebuilt and enlarged.

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[a] Eng. and Min. Jour., vol., 80, 1905, p. 64.

The United States Zinc Company, at Pueblo, Colo., produces the only spelter made in the West. The plant was erected in 1903 by a German company on the plans of the smelter at Overpelt, Belgium. A half interest in the property soon passed to the American Smelting and Refining Company, which later obtained control and is now engaged in doubling the capacity, which consists of 6 furnaces of 240 retorts each. The retorts are of unusual size, and about 75 tons of unroasted ore can be handled per day. It has been described by O. Pufahl.[a] The ore is crushed to 2-millimeter size, roasted to a sulphur content of 1.5 to 2 per cent, and retorted with a mixture of coke, anthracite, and soft coal. Salt is added, and formerly lime was put in, but this is no longer done. The retorts are made of Colorado clay and are hydraulic pressed. They are glazed on the outside with powdered glass and sodium silicate solution, and they last 20 to 25 shifts. The distilling is carried on very slowly, only two drawings of metal being made in twenty-four hours. The charge carries as high as 20 per cent of iron and 5 per cent of lead, but the crude metal contains only 2 per cent of lead and 0.05 to 0.06 per cent of iron. This is reduced by melting and refining so that a metal suitable for all ordinary purposes is produced. The spelter goes mainly to the western markets and to export trade. The plant supplies all the refining furnaces of the American Smelting and Refining Company and the galvanizing plant of the Colorado Fuel and Iron Company. The retort residues, running 6 to 8 per cent in lead and containing the gold and silver values, are sent to the lead furnaces of the American Smelting and Refining Company. The plant is designed to handle low-grade ores only, preferably those running 25 to 33 per cent in zinc. Lead as high as 17 per cent and silver running up to 50 ounces per ton may be smelted. Ore running above 33 per cent in zinc is usually more economically handled at an ordinary zinc furnace, even at the sacrifice of precious metal values. The zinc saving of the plant is said to range from 85 to 92 per cent, running usually about 88 per cent. In view of the low grade and complex character of the ore this is very good.

The United States Smelting Company, at Canyon, Colo., uses the Bartlett process, whereby a zinc-lead pigment is made, while the gold, silver, and copper values are left in the cinder on the grate, in form suitable for ordinary reduction. The ores range in zinc content from 20 per cent up, and carry 5 to 20 per cent of lead, silver up to 50 ounces to the ton, and small copper and gold values.

The ore, in the form of a sulphide, is burned with a forced draft on a grate similar to that used in ordinary oxide making. The zinc is converted to the oxide and most of the lead to a sulphate. The fumes are caught in a bag house, and after being refined to improve the color are used as a basis for mixed paints. The cinder left on the grate is mixed with low-grade copper ore and reduced in a furnace which produces a 25 per cent copper matte. This furnace has a low fusion zone, 18 inches, and is run with a hot top, so that any lead or zinc left in the cinder is driven off as a fume, and after settling is treated as is that from the oxide furnaces. The plant has been in operation for several years and furnishes a market for a peculiar grade of ore not elsewhere readily salable.

Markets and prices.—In the Rocky Mountain region zinc ore is not bought upon any standard basis as at Joplin. There is so much difference in the character of the ore of different mines and the processes of treatment are so unlike that as yet prices are far from uniform. The bulk of the ore is sold on long-time contracts entered into between individual mining and smelting companies. These are usually written in terms of the zinc content only, but in some cases specific allowance is made also for lead, silver, gold, copper, and occasionally for excess of iron. Even in the cases where these items are not mentioned they are evidently taken into account and help to fix the price per unit for the zinc. If it were not for the presence of these other values comparatively few of the western mines could run. The value of the zinc

[a] Eng. and Min. Jour., vol. 81, 1906, p. 1231, quoting Zeitschr. für Berg-Hütten u. Salinenwesen im preuss. Staate, 1905, LIII, 438.

alone, in view of the high mining costs and the long railway hauls, would not be sufficient to warrant production.

It is impossible to give average prices, but the following may serve to illustrate their range. In one case ore is now netting $9.50 to $12 per ton, being sold for zinc only. The price varies with the average St. Louis spelter quotation for the preceding month. The composition of the ore is about as follows:

Composition of Rocky Mountain zinc ore.

Zinc.......per cent..	35	Silica.......per cent..	21
Iron.......do....	2	Silver.......ounces..	6
Lead.......do....	8	Gold.......do....	.03

The same ore had netted about $7 to $8 per ton when sold to another company which made direct allowance for the values other than zinc. In the latter case 90 per cent of the market price was paid for lead ore over 12 per cent, and gold and silver were paid for as in lead ores. A mixture running 28 per cent zinc and 17 per cent lead was preferred and ore carrying up to 31 per cent of zinc was bought.

In another place $14 net is paid for 40 per cent zinc ore and $20 bid for 50 per cent ore, no account being taken of the gold, silver, or lead. One of the re-treatment mills has bought ore on the bases of $5 a ton for 35 per cent ore and 30 cents a unit up or down. In still another place 40 per cent ore having small values in gold, silver, and lead nets $10.50 per ton.

In general it may be said that in nearly every western camp 40 per cent zinc ore is now readily salable, ore ranging from 30 to 40 per cent can be handled in most of them, and ore ranging from 20 to 30 per cent is in demand in many. Ores below 20 per cent in grade must be concentrated, and it is often economical to concentrate ores running as high as 30 per cent in zinc. Although the losses in tailings are sure to be high, the bulk of the gold-silver values can in this way be thrown into a very desirable lead-iron product. By adopting this method ores running as low as 10 per cent in zinc, if they carry also gold-silver values, can be worked in most of the western camps. In Colorado, under favorable conditions, ore as low as 7 per cent in zinc is concentrated, and 15 per cent is sold to the re-treatment mills.

Zinc-carbonate ores, because they may be directly converted to zinc oxide, can usually be marketed, if they contain over 20 per cent of zinc. If they have low values in copper, gold, or silver, it is an advantage, but lead is a disadvantage.

The most important markets for the western ores are Denver, Pueblo, and Canyon, Colo. At these points they are either smelted or milled in transit and sent on to Iola and other eastern Kansas points. Freight rates are, on the whole, low. From Leadville to eastern Kansas the rate is $3.50 per ton; from Salt Lake City to Colorado common points, $4, with $2 from there to Iola; from Frisco to Salt Lake City $2 is charged. From British Columbia points to eastern Kansas there is a rate of $9, but in this case there are tariff complications.

PRODUCTION.

The United States Geological Survey has hitherto collected the statistics of metallic zinc, and detailed figures of zinc ore production in the Western States are not available. Mr. W. R. Ingalls gives the following estimates of ore produced and sold to spelter manufacturers:

Estimated zinc ore production of Rocky Mountain States.[a]

	Short tons.		Short tons.
Colorado	105,500	Idaho	1,700
New Mexico	20,000	Total	138,465
Utah	9,265		
Montana	2,000		

[a] Eng. and Min. Jour., vol. 81, 1906, p. 909.

The production of New Mexico is stated to have been estimated and subject to revision, and a small additional output is credited to Arizona and Nevada. Besides the above tonnage, 33,000 tons, averaging 22.7 per cent zinc and 8.8 per cent lead, were used at Canyon, Colo., in making lead-zinc pigment. Of this, 800 tons is to be credited to Arizona and the remainder to Colorado. These figures are probably substantially correct, except that the New Mexico production is too high.

Colorado.—As already indicated, the principal western production comes from Colorado, and in this State Leadville is the leading zinc camp. Ores ranging from 20 per cent up in zinc content are now shipped, the greater portion going to re-treatment mills, where the ores are raised in grade and decreased in bulk before going to the smelter. This produces the anomaly that there is more ore shipped from Leadville than from the whole State including Leadville. As the ore leaves the camp it runs mainly from 30 to 36 per cent in zinc. In 1904, 72,000 tons of the shipments averaged 31.4 per cent, and in 1905, 13,969 tons shipped averaged a trifle less than 36 per cent. Before this goes to the smelters the bulk of it is concentrated so as to run 45 to 50 per cent in zinc.

In Leadville the most important producers are the Moyer mine of the Iron-Silver Company, and the various properties of the Western Mining Company. The Small Hopes, Ibex, and several other companies also ship zinc. The bulk of the ore is sold crude, but there are two wet concentrating mills belonging to the Western Mining Company which run on ore carrying about 20 per cent and produce concentrates ranging from 30 to 35 per cent in zinc. The main object in the milling is to reduce the silica and to separate from the zinc a lead-iron product which carries most of the silver-lead values. The Rho is the only dry process mill in the district. It is situated at the mouth of the Yak tunnel. The ore here is dried, crushed in ball mills, and passed through International magnetic separators, producing as usual a zinc and a lead-iron concentrate. The mill is new and well equipped for automatic handling of ores. No data are available as to its work.

The ore deposits of Leadville have been frequently described. From the point of view of zinc producers the immense size of the ore shoots is the most striking feature. These are in flat-lying limestone, and in ground plan measure from 100 by 300 to 200 by 600 feet. Vertical faces of ore 60 feet high are exposed. It should be remembered that this is solid ore of the sort now shipped, running 20 to 30 per cent in metallic zinc. These bodies are found below the great shoots of lead carbonate, which gave early fame to the camp. While the ore bodies formerly worked were reputed to be free from zinc, it was present in quantities sufficient to interfere seriously with ordinary lead smelting.

Next to Leadville, Creede is the most important producer of zinc in Colorado. The ore here is unusual for the region in being free from iron. A high-grade concentrate, rivaling that of Joplin, is obtained by simple wet concentration. In Clear Creek County zinc is produced at a number of mines, particularly near Silver Plume. The Mendota, Bismark, and Waldorf companies are the main shippers. The ore is sold crude or concentrated in wet mills, which produce concentrates running 33 to 46 per cent in zinc. Occasionally lower grades are sold for treatment in Denver. The ore shoots are not large, and zinc production is incidental to precious metal mining. Zinc ore is shipped regularly from Kokomo, in Summit County, and small lots are sold from Silverton, Rico, and other points in the San Juan region.

New Mexico.—The principal production in New Mexico is from the Graphic and Kelley mines, in the Magdalena Mountains. These have been described by C. R. Keyes.[a] The ore bodies form very large ore shoots, and in many particulars the occurrence is similar to that at Leadville. At Magdalena, however, the ore has been largely converted to carbonate, and copper is more abundant than at Leadville. Sulphide of zinc is found with the carbonate, and considerable sulphide was shipped

[a] Keyes, C. R., Zinc carbonate ores of the Magdalena Mountains. Min. Mag., vol. 12, pp. 109–114.

in 1905. The Kelley mine did not ship heavily this year, as a new shaft was being sunk and other arrangements made for a large future production. The Graphic mine shipped carbonate ore direct to the Ozark Oxide Company at Joplin, Mo., with which it is affiliated, and sulphide ore to Gas, Kans., where it was roasted before shipment to the oxide works.

In southwestern New Mexico zinc ore is also produced in Grant and Dona Ana counties. In the former, at Hanover, considerable quantities have been taken out by the Empire Zinc Company; at Tres Hermanos, Thurman and Lindauer are shipping oxidized ores; and at Pinos Altos, the Comanche Mining and Smelting Company has begun to ship. In the Organ Mountains the Copper Bar Mining Company reported some shipments in 1905.

Arizona.—Zinc has been found at several points in Arizona, but the only shipments in 1905 are reported by Mr. Victor Heikes to have been made by the Copper King Mines Company, operating in the Tiger district of Yavapai County. The ore shipped was prepared by concentrating, with Dimmic tables, material taken from old dumps.

The litigation which has tied up this property for several years having been recently settled, regular production may now be expected.

Utah.—The zinc production of Utah at present comes largely from Park City and Frisco. At the former camp the Daly-West is the main producer, and at Frisco the Horn Silver. The ores from Park City are re-treated at Salt Lake City by the Western Ore Separating Company, and yield a concentrate running 36 to 42 per cent in zinc. The mine is described by J. M. Boutwell.[a] A number of other mines in this district contain important quantities of zinc ore and may be expected in time to become producers.

The Horn Silver mine at Frisco, which has been an important producer of silver and lead for many years, is now shipping zinc regularly. The ore body has been described by S. F. Emmons[b] as occurring "along a faulting fissure at the contact of an altered igneous rock and a dolomite of uncertain age and near a mass of monzonite. The limestone where in contact with the monzonite has been subjected to contact metamorphism." The workings extend to a depth of 1,600 feet and to a distance of a half mile or more along the strike of the vein. The working face where seen between the 500-foot and the 900-foot levels is 15 to 25 feet wide, and shows zinc blende, galena, and pyrite cementing and replacing crushed masses of the country rocks. The ore is sufficiently high in zinc to be shipped without concentration, and about 12,000 tons have been shipped. The range in composition is about as follows:

Composition of Horn Silver mine zinc ore, Utah.

Zinc ....per cent..	34 to 42	Silica ....per cent..	20 to 22
Iron ....do....	1 to 3	Silver ....ounces..	$2\frac{1}{2}$ to 12
Lead ....do....	5 to 14	Gold ....do....	0.03

The ore is a peculiar brown to red color, and consists mainly of sulphide, but is said to be in part also sulphate. It has the little understood property of "triboluminescence"—becoming luminous when scratched with steel. Gypsum and other sulphates are abundant, and the whole ore body is within the zone of oxidation. It is not practicable to give estimates of the amount of ore in sight, but a very large tonnage is available, even without concentration, which, in the absence of fuel and water, would be difficult and expensive.

Nevada.—Zinc ore occurs at several points in Nevada in connection with lead-silver ores, but very little has yet been mined. Near Reno it is found and has been

[a] Boutwell, J. M., Prof. Paper U. S. Geol. Survey. (In preparation.)

[b] Emmons, S. F., The Delamar and Horn Silver mines, Trans. Am. Inst. Min. Eng.. vol. 31, 1901, pp. 675-683.

shipped. In the Spring Mountains, near the old Potosi mines, a considerable quantity of zinc carbonate has been found. It occurs in Mississippian limestone, and in appearance and form of ore body has certain resemblances to the Wisconsin ore bodies. It has been elsewhere described.[a] Carbonate ore running 40 to 45 per cent in zinc and about 12 ounces of silver is shipped, being hauled to Las Vegas. A peculiarity of local practice is that the ore is roasted before shipment to reduce the weight and raise the grade. This, while common in Europe and formerly practiced in Wisconsin, is not, so far as known, carried on elsewhere in the United States. Owing to difficulties in using poor wood for fuel the results are not very satisfactory. In one test run on a lot of 400 pounds the grade was raised from 39.4 to 42.4 per cent, with a loss of 14 per cent in weight.

Montana.—The center of zinc production in Montana is at Butte. In the old silver-lead mines of this camp there are considerable bodies of ore which formerly could not be worked because of the zinc penalty. Under present conditions much of this ore is of value. The principal output is handled by the Montana Zinc Company, which has remodeled one of the old silver mills for that purpose. Both wet and dry concentration are employed. The crude ore is crushed to 24 mesh, sized, and run over Wilfly tables, making a lead-iron product carrying most of the gold and silver, zincky middlings, and siliceous tailings. The zincky middlings are dried and treated on the Blake machine, of which there are 13 in the plant. Here again a lead-iron and a zinc concentrate are made. The lead-iron concentrates are shipped to the East Helena smelter of the American Smelting and Refining Company. The zinc concentrates go to the Lanyon smelter, at Iola, Kans. Concentrates running as high as 55 per cent in zinc with 3.3 per cent of iron have been produced from crude ore, running 14.6 per cent zinc and 30.5 per cent iron, but the average separation is not so good. The analyses given below are representative rather than strict averages.

Analyses of Butte zinc ores.

	(1) Lexington.	(2) Blake.	(3) Blake.	(4) Alice.	(5) Blake.	(6) Blake.
	Crude.	Zinc concentrates.	Iron product.	Crude.	Zinc concentrates.	Iron product.
Zinc ..... per cent..	16.9	26.8	7.5	16.8	42.4	9.9
Iron ..... do....	7.7	8.2	28.4	8.5	3.9	29.5
Lead ..... do....	1.5	4.5	14.6	6.7	2.8	12.9
Silica ..... do....	46.6	27.6	5.4	40.7	15.7	4.0

	(7) Lexington.	(8) Blake.	(9) Blake.
	Crude.	Zinc concentrates.	Iron product.
Zinc ..... per cent..	20.6	34.7	15.4
Iron ..... do....	9.4	10.6	21.9
Lead ..... do....	6.0	6.2	15.0
Silica ..... do....	41.6	14.7	7.4
Silver ..... ounces....	4.10	6.7	10.0
Gold ..... do....	.06	.09	.14

The Montana Zinc Company began operations in April, 1905. The company buys the crude ore, treats it, and sells the concentrates. It has handled, in addition to the ore from Butte, small lots from various points in Montana, as also from Burke, Idaho.

[a] Bain, H. F., A Nevada zinc deposit, in Contributions to Economic Geology, 1905: Bull. U. S. Geol. Survey No. 285, 1906, pp. 166–169.

Idaho.—Zinc is found and is now mined in both northern and southern Idaho. In the Coeur d'Alene district it is currently stated that the lead occurs free from zinc. This statement is not entirely correct. The ore shoots now worked are, indeed, remarkably free from zinc, but the average feed analyses for the first seven months of 1905 at one of the large mills showed 1.7 per cent of zinc and 6.8 per cent of lead. At another for the same period the corresponding percentages were 3.8 zinc, 6.1 lead. As these figures represent many thousands of tons it is evident that much zinc is even now going through the mill; in one case practically two-thirds as much zinc as lead, and a quantity almost as great as is found in the crude ore of some of the Joplin mines. In time, and as zincky ore shoots are encountered, the mills will doubtless be altered so as to save the zinc as well as the lead. At present, attention being concentrated on the latter, zinc-bearing ore shoots are avoided. The ore being generally sold with a 10 per cent zinc penalty the small quantity present does not attract attention. The Helena-Frisco mine is said to have encountered zinc in depth; the Hercules has shipped a small quantity of hand-picked ore; and the Granite mine was reopened in 1905 by the Success Mining Company for the especial purpose of working the zinc ore known to be present. An ore shoot 12 feet across has been developed 80 feet along the vein. It has been cut on two levels 400 feet apart, and an upraise 100 feet from the lower shows the ore in full thickness. It is said to assay 37 per cent zinc and 17 per cent lead. The ore is a dense brown to black mass with very little silica, and when crushed to 80 mesh and run over Wilfley tables it has produced lead concentrates running 56 per cent, and zinc concentrates running 45 to 50 per cent. It seems probable that other equally valuable ore shoots will be found in this region.

In southern Idaho the zinc ore so far mined has come mainly from the Wood River district. The Lucky Boy mine, 14 miles from Ketchum, is the main producer. The ore body occurs here in a faulted limestone near "syenite." The vein shows a thickness of 4 to 8 feet of ore, which carries very little lead, silver, or gold. As shipped it runs 40 to 43 per cent in zinc.

EXPORTS AND IMPORTS.

Relatively little zinc ore is now exported. From New Jersey 30,448 tons were sent out. This is about the usual quantity. Ore from Joplin has from time to time been shipped through Galveston, and since 1899 Colorado ore has gone out through this port rather regularly. The development of the western smelting industry has, however, made a home market for this ore, and the export movement has practically ceased.

Imports of zinc ore began in 1904 and became so important as to attract attention in 1905. The ore came from both British Columbia and Mexico; about 8,000 tons were brought in from the former, and 30,000 from the latter. It is exceedingly difficult to get at the exact tonnage owing to the differences in classification. At the time the present tariff law was enacted it was not anticipated that zinc would be imported. The matter gave rise to protests to the Treasury Department in 1905 by the representatives of the Joplin mines, and there is still much confusion as to the application of the schedules.

QUICKSILVER.

By F. W. Horton.

PRODUCTION.

The production of quicksilver in the United States during 1905 amounted to 30,451 flasks (of 75 pounds net each), valued at $1,103,120, as compared with 34,570 flasks, valued at $1,503,795, in 1904, a decrease in quantity of 4,119 flasks and in value of $400,675. This output was produced by four States as follows: California, 24,635 flasks; Texas, 4,723 flasks; Utah, 1,050 flasks; Oregon, 43 flasks—in all, 30,451.

This falling off in production was due primarily to a lack of demand and a consequent decline in price, and also to a depletion of the richer ore bodies in some of the larger mines. These, together with other causes for a decreased production, will be discussed in detail under other headings.

CALIFORNIA.

The quantity of quicksilver produced in California during 1905 was 24,635 flasks, valued at $886,081, as compared with 29,217 flasks, valued at $1,270,200, in 1904. This output represents 81 per cent of the total production of the country.

Total production of quicksilver in California, 1850–1905.

[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	30,526
1866	46,550	1885	32,073	1904	29,217
1867	47,000	1886	29,981	1905	24,635
1868	47,728	1887	33,760	Total	1,997,344

The decrease of 4,565 flasks in the quantity of quicksilver produced in California during 1905 is due rather to a lessened production of all the mines than to any serious falling off in the output of any single one, with the exception, perhaps, of the New Almaden property in Santa Clara County. This is the oldest quicksilver mine in the country, and for years was the largest producer on this continent. The place that it held in the production of quicksilver is best indicated by the fact that of the total output of the whole State of California during the last fifty-five years nearly 2,000,000 flasks, fully one-half, has been produced by the New Almaden. At present the New Idria mine in San Benito County is the largest producer in the State. The Napa Consolidated, in Napa County, and the New Almaden come next as regards output. The Oceanic, the Great Western, the Great Eastern, the Socrates, the Karl, and the Altoona are the other principal producing mines of the State.

The outlook for an increased production of quicksilver in California is not encouraging, and a further decrease in the output for 1906 is indicated by the decline in production from 3,449 flasks in January and 2,526 flasks in February of 1905 to 1,588 flasks in January and 1,904 flasks in February of 1906—a decrease of 861 and 622 flasks, respectively.

The production of quicksilver in California, by counties, for 1904 and 1905 is given in the following table:

Production of quicksilver in California, by counties, during 1904 and 1905.

[Flasks of 76½ pounds net; 75 pounds net since June 1, 1904.]

County.	1904.		1905.	
	Quantity.	Value.	Quantity.	Value.
Colusa	400	$17,400	326	$12,321
Lake	3,044	132,414	1,462	51,937
Napa	5,329	231,811	4,853	171,910
San Benito	8,480	368,880	7,967	286,959
San Luis Obispo	4,896	212,976	3,510	126,440
Santa Clara	3,889	169,172	2,693	95,968
Solano and Santa Barbara	377	16,400	601	20,588
Sonoma	2,700	117,450	2,584	97,041
Trinity and Kings	102	4,437	639	22,917
Total	29,217	1,270,940	24,635	886,081

TEXAS.

The developments in the quicksilver industry in Texas during 1905 were the most important in this country. They have been described in several articles (see bibliography at close of this report), to which the reader is referred for details. During the present summer a member of the United States Geological Survey will make a reconnaissance examination of the quicksilver resources of this section. Pending the publication of the results of that examination the following summary statement has been prepared from recent publications.[a]

LOCATION.

The quicksilver deposits are situated in the extreme southwestern part of the State in the southwestern corner of Brewster County, about 300 miles southeast of El Paso, about 100 miles south of the line of the Southern Pacific Railway, and from

[a] Phillips, W. B., the quicksilver deposits of Brewster County, Tex.: Econ. Geology, vol, 1, No. 2, 1905, p. 155; Terlingua quicksilver district: Mining World, Sept. 2, 1905; A new quicksilver field in Brewster County, Tex.: Eng. and Min. Jour., Jan. 28, 1904.
Hill, B. F., Terlingua quicksilver deposits: Bull. Texas Univ. Min. Survey No. 4, 1902.

7 to 15 miles north of the Rio Grande. They lie in three areas, known, respectively as Terlingua, Study Butte, and Chisos districts.

The Terlingua district comprises an area of about 25 square miles in the immediate vicinity of Terlingua. The Study Butte district embraces about 6 square miles about 10 miles east from Terlingua. The Chisos district, the last discovered and the least developed, lies immediately east of the districts mentioned and southeast of the Chisos mountains.

OCCURRENCE.

The country rock in this region comprises limestones, shales, and marls of Cretaceous age, and effusive rocks, andesite, phonolite, and rhyolite of Tertiary age. The quicksilver ores have thus far been found in the limestones, shales, and rhyolite, but nowhere in the sandstone nor in the marls.

In the Terlingua district the prevailing form of occurrence is as veins of cinnabar, in northeast-southwest calcite veins, in cavernous, close-grained limestone. Native quicksilver and oxychlorides are also present. The grade of ore varies greatly, ranging from 0.50 to 2.50 per cent. One of the largest furnaces was recently running on 0.75 per cent ore; mixtures, however, rarely fall below 2 to 2.50 per cent.

In the Study Butte district the quicksilver commonly occurs as cinnabar in shales and occasionally in both veins and disseminations in rhyolite.

In the newer districts which are being prospected to the north of Christmas Mountain and south of the Chisos mountains cinnabar is found in limestone, as at Terlingua.

COMMERCIAL CONSIDERATIONS.

The development of this industry in this region is seriously impeded by deficiency in water supply, railway facilities, and fuel. The Terlingua district depends for its supply for six months in the year on water caught in reservoirs during the rainy season, and for the remainder of the season on water hauled in tanks from Terlingua Creek (6 miles) and the Rio Grande (15 miles). The price is $2.50 to $3.50 per tank of 350 to 500 gallons. The Study Butte and the Chisos districts are more advantageously situated in this respect, as the former is traversed by Terlingua Creek, and the latter lies within 6 miles of the Rio Grande. The Southern Pacific Railroad at Marfa, Alpine, and Marathon, the nearest point, is 105, 95, and 90 miles, respectively, north from Terlingua. Wood, which is scarce and becoming exhausted, costs from $6 to $7 a cord. Cretaceous coal in seams averaging from 10 to 12 inches in thickness occurs in accessible localities in limited quantity.

MINING.

The mining methods employed in this region are extremely crude. Most of the ore is excavated by pick and shovel from shallow open cuts following the course of the veins. Drifting along the veins from shallow shafts is practiced to some extent. The broken ore is either hoisted to the surface by means of rude windlasses or is packed up "chicken" ladders by the Mexican miners in rawhide buckets. The deepest shaft in the region is down only about 300 feet, in limestones. The shales have been penetrated only to a depth of 220 feet.

After the ore has been brought to the surface it is hand picked and sorted into different grades. It is then hauled to the furnaces, where it is passed over grizzlies to sort out the fine ore, and the coarser material is then crushed to 1 to 2 inch size in jaw machines of the Blake type. Gasoline engines furnish the necessary power to run the crushers and also to drive belt conveyors, which take the crushed material to the ore bins, where it is stored until needed to supply the furnaces.

REDUCTION.

The reduction of the quicksilver is effected either in furnances or retorts. Of the seven active companies in the field five employ Scott continuous furnaces, the other two use retorts of different types. The construction and operation of these, together with a description of the condensers used, is discussed later under the heading of Methods of Quicksilver Reduction.

In this district furnace ore generally runs from 1 to 2½ per cent quicksilver, but material containing as small a quantity as three-fourths of 1 per cent is profitably treated. For retort work a much richer grade of ore is necessary, as the losses incurred are very large. Generally such ore runs from 5 to 20 per cent metal.

The chemistry involved in the operation of reduction is comparatively simple. In the furnace the chief reaction which takes place is $HgS+2O=Hg+SO_2$. The sulphur in the heated ore is oxidized by the air to SO_2 and the liberated mercury is volatilized to be later condensed and collected. All of the condensers used in the district are air cooled, as the scarcity of water precludes its use for this purpose. This means that for efficient work the number of condensers must be greater than where water cooling can be utilized.

In the retort, lime is generally added to furnish a reagent to unite with the sulphur, the reaction that takes place being $4HgS+4CaO=4Hg+3CaS+CaSO_4$.

OPERATING COMPANIES.

Following is a list of companies engaged in the active mining of quicksilver ore in this region.

Quicksilver mining companies in Texas.

Marfa and Mariposa Mining Company	Terlingua.
Terlingua Mining Company	Terlingua.
Lone Star Mining Company	Terlingua.
The Chisos Mining Company	Terlingua.
The Big Bend Cinnabar Mining Company	Big Bend.
The Colquitt-Tigner Quicksilver Mining Company	Terlingua.
The Texas Almaden Mining Company	Big Bend.

Of these the first five were actual producers during the year 1905, but at present (March 1, 1906) only two companies, the Marfa and Mariposa and the Chisos, are producing.

The Marfa and Mariposa Mining Company has two 10-ton Scott furnaces in operation. It was one of the first companies organized, and has been a remarkably steady producer ever since the opening of the field.

The Terlingua Mining Company operates its 50-ton Scott furnace at intervals, mining and stocking ore until there is enough on hand for a run of six or eight weeks. The last run was made during the summer of 1905, and it may be some time before there is sufficient ore on the dumps to warrant another run.

The Lone Star Company has 12 Johnson retorts, not now in operation, but to be started again soon. The plant has shut down temporarily to install additional machinery.

The Chisos Mining Company has 4 D-retorts, of which it is now operating two. This company is at present largely devoting itself to development of its properties.

The Big Bend Cinnabar Mining Company has a 50-ton Scott furnace, which closed down last September and has not been run since.

The Colquitt-Tigner Company has a 10-ton Scott furnace, but it has been idle now for almost two years. At one time this property yielded some very fine ore; and recent rich finds which have been made in the immediate vicinity may induce the company to start work again.

The Texas Almaden Mining Company is building a 20-ton Scott furnace. It is expected to be completed by April 1, and the company will then commence active operations.

Of the companies mentioned, the mines of the Marfa and Mariposa, the Terlingua, the Lone Star, and the Colquitt-Tigner are all in lower Cretaceous limestone; the Chisos, the Big Bend, and the Texas Almaden companies are mining in the upper Cretaceous shales.

PRODUCTION.

The production of quicksilver in Texas during 1905 was 4,723 flasks, valued at $173,362, as compared with 5,336 flasks in 1904, valued at $232,116, a loss of 613 flasks in quantity and of $58,754 in value. This output for 1905 represents 15.53 per cent of the total production of the country. The decrease in the output was in a large measure due to a very heavy decline in the price of quicksilver. Then, too, the field is in a state of transition; many of the companies are either changing their method of reduction, installing new plants, machinery, etc., or are confining themselves to developing their properties. Work along these lines makes a present actual production a matter of secondary importance, but it is a great factor toward increasing future production.

The following table gives the annual production of Texas from 1899 to 1905, inclusive:

Production of quicksilver in Texas, 1899–1905.

[Flasks of 76½ pounds net; 75 pounds net since June 1, 1904.]

	Flasks.
1899	1,000
1900	1,800
1901	2,932
1902	5,319
1903	5,029
1904	5,336
1905	4,723
Total	26,139

FUTURE PROSPECTS.

Whether Texas is to take an important place as a quicksilver-producing State depends upon two things: First, upon the enlargement of the existing field; and, second, upon the development of the properties already located and the proving of the existence of good ore at considerable depths.

The extension of the field seems almost certain. Active prospecting is daily bringing to light new deposits, and there is a large area of country, as yet only partly prospected, having identically the same geological formation as that in which the deposits have been found. As to whether the ore is contained merely in surface deposits, or whether it continues to considerable depths, little can be said. A study of the geological conditions does not materially assist in answering this question, as the source of the quicksilver is in dispute. However, it is known that in the deepest shaft in the region, which is down 200 feet, as good ore is found at the 200-foot level as on the surface. The question of how much deeper it goes must be answered by the further development of the existing properties.

OREGON.

During 1905 the quicksilver production of Oregon amounted to only 43 flasks,[a] valued at $1,677. This quicksilver was all produced in a small experimental furnace which was operated for about one month at the Black Butte quicksilver mine. This mine is situated in Lane County, about 150 miles south of Portland, and is the

[a] It is understood that these flasks were not standard, but a special size (model flasks) made for exhibition use.

largest in the State, with over 3 miles of workings and one shaft down 1,600 feet. Black Butte Mountain, in which it is located, is composed of a much broken and altered andesite, and the cinnabar is found both in veins along the fracture planes and also disseminated throughout the country rock. The Black Butte Company has a 50-ton Scott-Huttner furnace, which is to be remodeled and started in 1906. Later a 100-ton Dennis furnace may be erected.

In the so-called Meadows district, on the upper Rogue River, there are a half dozen small quicksilver mines said to be in good ore, but as yet they are little more than prospects.

Oregon produced 75 flasks of quicksilver in 1901, 200 flasks in 1900, and 65 flasks in 1887.

UTAH.

The production of quicksilver in Utah during 1905 was 1,050 flasks, valued at $42,000. The entire quantity came from the retorts of the Sacramento Gold Mining Company, whose mines are located near Mercur, Tooele County.

ARIZONA AND NEVADA.

During the year discoveries of quicksilver have been reported from Yavapai County, Ariz., and from Washoe County, Nev.

In Yuma County, Ariz., the Colonial Mining Company is doing considerable development work on its property located at Cinnabar, 14 miles from Ehrenberg. This company has a 7-foot vein of ore said to average about 1½ per cent quicksilver.

In 1904 Nevada produced 17 flasks of quicksilver, and 65 flasks in 1903.

PRICES.

During 1905 the price of quicksilver suffered a heavy decline, due to a marked decrease in demand. The average San Francisco price for the year was $36.22 per flask of 75 pounds. Corresponding average quotations were $44.10 per flask in 1902, $45.29 in 1903, and $43.50 in 1904.[a] In San Francisco wholesale quotations of quicksilver for domestic delivery ranged from $37 to $42 per flask, and metal for export was quoted at $35 to $41. In New York prices were $38 to $42.50 per flask, and in London from £7 2s. 6d. to £7 12s. 6d. per flask.

The decrease in the demand for quicksilver, and the consequent decline in price, was largely due to the modern practice of smelting silver and gold ores, when feasible, in place of subjecting them to amalgamation processes. Numerous improvements have been made in methods of amalgamation also, which tend to lessen the mercury losses during the process.

USES OF QUICKSILVER.

The principal use of quicksilver is in the amalgamation of silver and gold ores. The demand for this purpose practically regulates the price of the metal. Considerable quantities are also used in the manufacture of a vermilion pigment, but this industry is suffering a decline occasioned by the competition of cheaper but inferior red of the vermilion shade made with aniline dyes. In industrial chemistry quicksilver is used to quite an extent as an electrode in various processes. For example, in the manufacture of caustic soda a solution of common salt is subjected to electrolysis, and the metallic sodium set free combines with the mercury electrode, forming sodium amalgam, which when treated with water liberates sodium hydrate.

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[a] The standard weight of the quicksilver flask was changed June 1, 1904, from 76½ pounds net to 75 pounds net.

mall quantities of quicksilver are used in medicine, as calomel or corrosive subliıate; as tin amalgam, in the manufacture of mirrors; for coating the zinc plates of lectric batteries; as gold, copper, or zinc amalgams in dentistry; in thermometers, arometers, and various other scientific apparatus; and in electrical machinery here moving or liquid contacts are desired. A new use for the metal is its employıent in the mercury vapor electric lamp.

REDUCTION OF QUICKSILVER.

The extraction of quicksilver from its ores is at present effected solely by dry rocesses. The ore (generally cinnabar, accompanied at times with small globules f native metal) is decomposed by heat and the liberated mercury is volatilized to e later condensed and collected.

Methods of extraction may be grouped into two general classes, according to hether the reduction takes place in tightly sealed iron retorts or in furnaces.

In the retort the decomposition is effected by the use of some reagent, such as lime r iron. The chemistry involved in the reduction is illustrated by the reactions—

$$4HgS+4CaO=4Hg+3CaS+CaSO_4, \text{ or } HgS+Fe=Hg+FeS.$$

lere the mercury vapor is kept entirely separate from the gases formed by the comustion of the fuel used in heating the retort.

In the furnace, the sulphur in the heated ore is oxidized by the air to SO_2 in ccordance with the reaction $HgS+2O=Hg+SO_2$. In this method the furnace ases come into direct contact with the ore and pass into the condensers with the ıercury vapor, as CO, CO_2, N, unused air, SO_2, etc.

The use of retorts is practically limited to the treatment of very rich ores, mercual soot, and concentrates. However, they may be used to advantage in treating nall lots of ore, in making test runs, etc., and on this account, together with their nall initial cost as compared with furnaces, they are generally adopted as a means reduction in first opening up a new property and preliminary to the building of a rnace. In comparison with the furnace, the retort has a very small capacity and e expense for fuel and labor is much greater. Retorts are also short lived, burng out rapidly even when great care is exercised in firing. However, they have e advantage of yielding the mercury vapor in a concentrated condition and undited by the furnace gases which prove so harmful in condensation of the quicksilver.

The furnaces in general use in this country are of the shaft type, and may be ıssed as "coarse-ore" furnaces and "fine-ore" or "tile" furnaces.

Omitting differences in detail between various styles, the "coarse-ore" furnace nsists of a cylindrical brick shaft into which the ore, mixed with the proper ıount of coke, coal, or wood, is charged at the top and the ashes and spent ore are noved at the bottom. A pipe issuing from the upper part of the furnace carries mercury vapor and hot gases to condensers. This type of furnace is unable to ndle fine ore successfully, so before the advent of the fine-ore furnace the fines re of necessity briquetted before treatment. At present the "coarse-ore" furnace been almost entirely done away with, the general practice being to crush the rse material to 1 or 2 inch size and treat it in the "tile" furnace.

'he "fine-ore" or "tile" furnace consists of a number of narrow rectangular .fts situated side by side, each provided with a series of inclined shelves or tiles ced in the opposite walls These shelves slope downward at an angle of 45° and e the ore, which is fed at the top of the furnace, to follow a zigzag path to the tom, where it is discharged. The end walls of the shafts are provided with open-, which allow the flames from the fire box to pass through the ore on the shelves. volatilized mercury, together with the furnace gases, pass into a vapor chamber then on into the condensers.

The length of time the ore remains in the furnace in order that a complete reduction may be effected varies from twenty to forty hours, depending to a large extent on the character and fineness of the ore, on the temperature to which it is subjected, and again on the particular style of furnace employed. The ore should neither be so large that the heat does not penetrate to the center of the largest pieces nor so fine as to pack. The temperature aimed at is that corresponding to a cherry-red heat.[a]

As to the type of furnaces employed abroad, the Cermak-Spirek is largely coming into use, especially in Italy.[b]

During 1905 a furnace for the reduction of quicksilver, which is a radical departure from existing types, was invented by W. B. Dennis, manager of the Black Butte quicksilver mine, Oregon. This furnace is fired by gas generated from wood, and, from experimental runs made with it, seems to possess many practical advantages.[c]

An interesting innovation in the installation of a furnace of the rotary type for roasting quicksilver ore has been made at the Socrates mine in Sonoma County, Cal. The furnace is known as the White-Howell rotary.[d]

The condensation of fumes from retorts, where the volatilized mercury generally forms the chief constituent of the gas, is easily accomplished; but in the case of furnace fumes, where the volume of the mercury vapor is often less than 1 per cent of the total volume of the gases, a complete recovery of the mercury presents many difficulties. Large quantities of CO_2, CO, N, air, and SO_2, carrying mechanically particles of ore, ashes, and soot, must be cooled and all condensible vapors separated out. In consequence, large and scientifically constructed condensers are an absolute necessity. Mr. Benj. F. Hill, in an article on the Terlingua quicksilver deposits of Texas,[e] says:

> The principles upon which the most successful condensers have been constructed are as follows:
>
> 1. Cooling of the furnace fumes by contact with large radiating surfaces exposed to the air.
>
> 2. Sedimentation of the condensed quicksilver particles in enlarged chambers where the velocity of the gaseous mixture is reduced
>
> 3. Constant exposure to friction surfaces, cross currents, and vortex motions to remove the globules of metal by calling into play the force of adhesion

The condensers generally used in this country are tall, narrow, brick chambers, divided into compartments by partitions and having cement floors, or floors constructed of iron plates laid in cement, which slope both ways from the center. On either side of the condensers are gutters for carrying the condensed mercury and acid waters to receiving tanks. In most cases the condensing chambers have water backs to facilitate the cooling of the gases, but in the Texas quicksilver field the scarcity of water precludes its use for this purpose and cooling takes place solely by radiation. A number of condensers are generally connected with one another in series, but sometimes a combination arrangement of series and parallel grouping is adopted, as for instance in the plant of the Marfa and Mariposa Mining Company, at Terlingua, Tex. In any arrangement of condensers the first one is generally employed as a dust chamber, in which the velocity of the gas current is sufficiently reduced to allow fine particles of ore, ashes, etc., to settle, but where very little quicksilver is condensed. The chambers immediately succeeding catch the bulk of the mercury, and the last condensers of the series should contain but little.

In cleaning up the condensers, which is done at intervals varying from two or three days to as many months, depending on the position of the condenser in the

[a] A detailed account of this type of furnaces, with plans, sections, dimensions, and other data, may be found in Trans. Am. Inst Min Eng., vol. 13, in an article on "Quicksilver reduction at New Almaden," by Prof. S. B. Christy. The reader is also referred to an article by R. B. Symington on "The present practice in the metallurgy of quicksilver in California" in Mineral Industry for 1899.

[b] A complete account of this furnace, together with a review of the quicksilver industry in Italy, may be found in Mineral Industry for 1898, in an article by Vicinie Spirek

[c] See description by Waldron Fawcett in The American Inventor, November, 1905.

[d] Its construction and operation are described in Min. and Sci. Press, January 14, 1905, by John W. Geary, on "The Rotary Furnace for Roasting Quicksilver Ores."

[e] Hill, B. F., Terlingua Quicksilver Deposits: Bull. Texas Univ. Min. Survey No. 4, 1902, p. 43.

series, finely divided quicksilver mixed with large quantities of soot is raked down from the sides and floors of the chambers through openings provided for that purpose. This material is generally worked over mechanically, being stirred and rubbed in pans to cause the globules of quicksilver to coalesce. In this way most of the mercury is extracted from the soot, which is then either returned to the furnace or is mixed with lime and retorted. Electrical and wet methods are also used in cleaning up this product, especially abroad. The quicksilver is cleaned by filtering through charcoal, and is then bottled in cylindrical iron flasks which contain 75 pounds. Detailed descriptions of the different types of condensers used may be found in the articles to which reference has already been made.

The principal losses which occur in the furnaces and condensers are given by Professor Christy as follows:

1. Furnace loss: Loss in residues from roasting furnaces.
2. Condenser loss: Loss of vapor or liquid in condenser structure.
3. Chimney loss: Loss of quicksilver in escaping gases, either in the form of vapor or as quicksilver "mist."

The first two of these losses are under control and can be practically eliminated by careful management and construction, and the third can be greatly reduced.

IMPORTS.

There is an import duty of 7 cents per pound on quicksilver, which is sufficient, practically, to prohibit importation. The following table shows only slight changes in the imports, which have been only nominal for the last decade:

Quicksilver imported and entered for consumption in the United States, 1900–1905.

[Pounds.]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1900	2,616	$1,051	1903	(a)	$1,065
1901	1,441	789	1904	(a)	1,405
1902	(a)	2,166	1905	2,690	1,710

a Not stated.

EXPORTS.

The exports of quicksilver from the United States during 1905 were 1,009,444 pounds, as compared with 1,611,635 pounds in 1904—a decrease of 602,191 pounds, or 37.4 per cent.

In the following table the quantity and value of quicksilver exported from the United States from 1900 to 1905, inclusive, are given:

Exports of quicksilver from the United States, 1900–1905.

[Flasks of 76½ pounds net; 75 pounds net since June 1, 1904.]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1900	10,172	$425,812	1903	17,577	$719,119
1901	11,219	475,609	1904	21,064	847,108
1902	13,247	575,099	1905	13,534	489,756

The following table gives the exports of quicksilver from San Francisco during the years 1904 and 1905:

Exports of domestic quicksilver from San Francisco in 1904 and 1905.

[Flasks of 76½ pounds net; 75 pounds net since June 1, 1904.]

Country.	1904.		1905.	
	Quantity.	Value.	Quantity.	Value.
China (Hongkong)	9,000	$350,290	3,000	$104,831
Mexico	3,433	145,004	5,572	201,310
Japan	2,582	99,553	3,283	121,372
Honduras	718	29,365	1,080	40,640
British Columbia	205	8,739	23	870
Korea	24	960	24	876
Costa Rica	59	2,482	17	668
Salvador	17	677		
Russia, Asiatic			3	115
Nicaragua	18	762		
British Australasia	294	12,200		
Philippine Islands	1	44	7	274
Canada			525	18,800
Total	16,351	650,076	13,534	489,756

WORLD'S PRODUCTION AND VALUE.

The principal foreign quicksilver producing countries are Spain, Austria, Italy, Russia, and Mexico. Together with the United States, they practically supply the quicksilver markets of the world.

In Spain the output of the famous Almaden mines is supplemented by the product of smaller deposits in the provinces of Almeria, Granada, and Oviedo. This country was for many years the leading producer, but in 1904 it was outranked by the United States. Most of the Spanish quicksilver is exported to London, England.

The Idria mines in Austria are very steady producers and make an annual output of from 510 to 550 metric tons.

In Italy the annual production of the quicksilver mines of Tuscany varies from 300 to 375 metric tons. The most important mine is the Siele, near Castell, Azzara. There has been considerable activity in the district during 1905, and new mines have been opened at Badia, San Salvadore, and Montebruno. All indications point to a steady, if not an increased, production from this province.

The total Russian output of quicksilver comes from the mines of A. Auerbach & Co., in the Ekaterinoslav district. During 1904 these mines produced 393 metric tons of the metal, most of which was exported to Hamburg, Germany.

In Mexico the principal deposits of quicksilver ore are at Huitzuco, in the State of Guerrero, and at Guadalcazar, in San Luis Potosi. There are also very promising deposits in Querétaro and Guanajuato; and the States of Morelos, Jalisco, Mexico, Hidalgo, Zacatecas, and Chihuahua also possess numerous smaller deposits.

Small quantities of quicksilver are annually produced in the mines of Huancavelica, Peru; in the Wang Shan Chang mines of Kweichow, China; and from the Taghit mines in Algeria. Quicksilver occurs also in British Columbia, Japan, Germany, Turkey, and New South Wales.

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.

RECENT PUBLICATIONS ON QUICKSILVER.

The following list comprises the most important articles on quicksilver which have appeared since the last report:

GENERAL.

YALE, CHARLES G. On the general condition of the quicksilver industry: Eng. and Min. Jour., January 7, 1906.

CALIFORNIA.

Cinnabar in San Luis Obispo County: Min. and Sci. Press, November 12, 1904.

Quicksilver production in California: Min. and Eng. Rev., January 28, 1905.

The Great Eastern quicksilver mine: Min. and Sci. Press, December 10, 1904.

TEXAS.

KIRK, M. P. Terlingua quicksilver district: Mining Mag., May, 1905.

PHILLIPS, W. B. Terlingua quicksilver district, Brewster County: Mining World, July 15, 22, 29; August 19, 1905, and September 2, 1905.

TURNER, H. W. The Terlingua quicksilver deposits: Econ. Geol., vol. 1, No. 3, December–January, 1906.

OREGON.

STOVALL, D. H. Quicksilver mining in Oregon: Mining World, January 28, 1905.

———. Oregon's quicksilver mine: Los Angeles Min. Rev., March 4, 1905.

A mercury deposit in Oregon near the producing state: Pacific Miner, March 1, 1905.

The Black Butte quicksilver mine exhibit: Mining World, August 12, 1905.

CANADA.

MONCHTON, G. F. Cinnabar-bearing rocks of British Columbia: Trans. Am. Inst. Min. Eng., vol. 27, pt. 5, 1904.

MEXICO.

BARRIGA, M. D. Mining in Mexico: Mining Jour., May 29, 1905.

CAPILLA, ALBERTO. Breves anotaciones sobre la mina de mercuria "La Gualalupana," San Luis Potosi: Mem. y Rev. Soc. Cientifica "Antonio Alzate," vol. 13, Nos. 9, 10.

MERRILL, F. J. H. The mercury deposits of Mexico: Mining World, February 17, 1906.

PAGLIUCCI, F. D. The quicksilver deposits of Huitzuco: Eng. and Min. Jour., March 2, 1905.

PERU.

UMLAUFF, A. F. El cinabrio de Huancavelica: Soc. Nac. de Min., Lima, Boletin Año 7, Nos. 77, 78.

ITALY.

Quicksilver in Italy: The Oil, Paint, and Drug Rev., May 27, 1905.

CHINA.

Brelich, Henry. Chinese methods of mining quicksilver: Min. Jour., Rwy. and Com. Gaz., May 27, 1905; also in Min. and Sci. Press, June 17 and 24, 1905.

REDUCTION.

Geary, J. W. A rotary furnace for roasting quicksilver ores: Min. and Sci. Press, January 14, 1905.

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STEEL-HARDENING METALS.

By Joseph Hyde Pratt.

INTRODUCTION.

Under the head of steel-hardening metals are included all the metals that are used for steel-hardening purposes, whether or not this is the main use of the metal. These are nickel, chromium, manganese, tungsten, molybdenum, vanadium, titanium, cobalt, and uranium, named in the order of the importance of their production and use for steel-hardening purposes. As manganese, however, is produced in large quantities for use in the purification of steel, its production is treated separately under the head of "Manganese ores." The minerals from which the metals included in this report were obtained in 1905 and the metals (in parentheses) so obtained are as follows: Smaltite (cobalt and nickel); chromite (chromium); wolframite, hübnerite, scheelite (tungsten); molybdenite, wulfenite (molybdenum); rutile (titanium); carnotite and uraninite (uranium). No production of cobalt or vanadium minerals in the United States during 1905 was reported.

So much practical work has been accomplished and so many investigations have been carried on in connection with the manufacture of crucible steel and of high-speed tool steels that it would seem as though there was but little chance of any further advance being made in this direction; yet the introduction of still other metals into the manufacture of steel has demonstrated also that they give to the new steel certain specific properties that make it especially adapted for certain particular purposes. This opens new lines of investigation into the change upon the character of the steel produced by using these alloys in varying proportions and into the commercial utilization of the new alloys. The metals mentioned are not only used alone in the hardening of carbon steel, but also in combination with one another, as nickel and chromium in the manufacture of armor-plate steel, and tungsten and chromium, or molybdenum and chromium, or tungsten, molybdenum, and chromium in the manufacture of tool steel. It is very probable that in the manufacture of the celebrated Damascus steel its strength and cutting qualities were attained largely by the method of tempering, but as has been indicated by Mr. J. M. Gledhill,[a] this famous steel contained small percentages of tungsten, nickel, and manganese, which may have been added to give the strength and toughness for which it is noted.

These metals are what have been proved at the present time to be of especial value in the manufacture of hardened steels for armor plate and for high-speed tools. It has also been shown by Mr R. A. Hadfield, of Sheffield, England, that it is necessary for carbon to be present in the steel in order that these metals shall really harden it. Mr. Gledhill has made a series of experiments with carbon steel

[a] Am Manf'tr, February 9, 1905, p. 151.

and with varying percentages of tungsten, molybdenum, and chromium as to their value in the manufacture of high-speed-tool steel. The results of these experiments are as follows:[a]

A number of tool steels were made, the carbon percentage varying from 0.4 per cent to 2.2 per cent, and the method of hardening was to heat the steel to the highest possible temperature without destroying the cutting edge, and then to cool rapidly in a strong air blast. By this simple method of hardening it was found that the greatest cutting efficiency is obtained where the carbon ranges from 0.4 per cent to 0.9 per cent, and such steels are comparatively tough. Higher percentagesare not desirable, because great difficulty is experienced in forging the steels, and the tools are inferior. With increasing carbon contents steel is also very brittle, and has a tendency to break with unequal and intermittent cutting.

Having thus found the best carbon content to range from 0.4 per cent to 0.9 per cent, the next experiments were made to ascertain the influence of chromium varying from 1 per cent to 6 per cent. Steels containing a low percentage are very tough and perform excellent work on the softer varieties of steel and cast iron, but when tried on harder materials the results obtained were not so efficient. With an increased content of chromium the nature of the steel becomes much harder, and greater cutting efficiency is obtained on hard materials. It was observed that with an increase of chromium there must be a decrease in carbon to obtain the best results for such percentage of chromium.

Mention may here be made of an interesting experiment to ascertain what effect would be produced in a rapid steel by substituting vanadium for chromium. The amount of vanadium present was 2 per cent. The steel rapidly forged, worked very tough, and was hardened by heating to a white heat and cooling in an air blast. This tool when tried on medium steel stood well, but no better than the steel with the much cheaper element of chromium in it.

The tungsten element is contained in by far the greater number of the present high-speed steels in use. A number of experiments were made, with the tungsten content ranging from 9 per cent to 27 per cent. From 9 per cent to 10.6 per cent the nature of the steel becomes very brittle, but at the same time the cutting efficiency is greatly increased, and about 16 per cent appeared to be the limit, as no better results were obtained by increasing the tungsten beyond this figure. Between 1.8 per per cent and 2 per cent it was found that the nature of the steel altered somewhat, and, instead of being brittle, it became softer and tougher, and while such tools have the property of cutting very cleanly they do not stand up so well.

The influence of this molybdenum at the present time is under investigation, and our experiments with it have so far produced excellent results, and it is found that where a large percentage of tungsten is necessary to make a good rapid steel, a considerably less percentage of molybdenum will suffice. A peculiarity of these molybdenum steels is that in order to obtain the greatest efficiency they do not require such a high temperature in hardening as do the tungsten steels, and if the temperature is increased above 1,000° C. the tools are inferior and the life shortened.

It was found that the presence of from 0 5 per cent to 3 per cent molybdenum in a high tungsten steel slightly increased the cutting efficiency, but the advantage gained is altogether out of proportion to the cost of the added molybdenum.

A number of rapid steels were made with silicon content varying from a trace up to 4 per cent. Silicon sensibly hardens such steels, and the cutting efficiency on hard materials is increased by additions up to 3 per cent. With the increase of the silicon above 3 per cent, however the cutting efficiency begins to decline. Various experiments were made with other metals as alloys, but the results obtained were not sufficiently good by comparison with the above to call for comment.

An analysis of one of the best qualities of rapid steels produced by the author s firm is as follows.[b]

Analysis of tungsten-chromium steel.

Carbon	0 55
Chromium	3.5
Tungsten	13.5

It is undoubtedly true that in the manufacture of a high-speed tool steel the most satisfactory results will be obtained by using the best qualities of iron, which are very free from impurities, and by using the highest grades of the various alloys and metals. In melting the steel and in adding the metal or alloy, care must be taken that the metals are thoroughly alloyed and that the resulting alloy is homogeneous. The annealing process should also be carried out carefully, as this has a tendency to make the steel more uniform in regard to its molecular structure, relieving internal strains which may have been produced by casting and tilting. It also increases the

[a] Am. Manf'tr, February 9, 1905, page 153. [b] A. W. Steel, analyst.

ductility, which is a property especially desired in tools that are subject to sudden shocks. A greater advance has undoubtedly been made in the manufacture of a high-speed-tool steel during the last few years than in the manufacture of any other kind of steel. In regard to armor plate and armor-piercing projectiles, experiments are constantly being made to increase their hardness and toughness, and in the case of armor plate the aim is not only to resist the impact of the projectile, but also to prevent bad fracturing of the plate when pierced by the projectile. For this purpose the nickel-chromium steel seems to give the best satisfaction. Tungsten has been experimented with, and is used to some extent in the manufacture of armor plate.

NICKEL AND COBALT.

On account of its close association with nickel in all nickel ores, cobalt is treated with nickel in these reports. There are but few ores containing nickel that do not contain 1 or more per cent of cobalt oxide, and, conversely, there are but very few cobalt minerals that do not contain 1 or more per cent of nickel. The most noticeable change during 1905 of the nickel and cobalt industry has been the development of the cobalt ores that were found in Bucke Township, Ontario, Canada, and that produced during 1905 a considerable quantity of cobalt. This ore also carries a large quantity of silver, which makes a very valuable by-product. On account of the small demand, there was readily an overproduction of cobalt, as the present uses of its oxide are limited, and up to the present time the metal has not been utilized commercially for steel or iron hardening purposes, although it gives to steel properties similar to those given by nickel. If, however, it should be produced in sufficient quantity and the price be reduced low enough, it is possible that it would enter into direct competition with nickel for steel-hardening purposes.

Although nickel has been found quite widely distributed throughout the United States, there have been no properties that have been worked primarily for nickel ores since the shutting down of the Gap nickel mine, in Lancaster County, Pa., which contained a nickeliferous pyrrhotite ore. For a number of years there has been obtained from the lead mines at Mine La Motte, Mo., a by-product matte from lead smelting which contained a small percentage of nickel and cobalt.

Missouri.—At Mine La Motte there are two classes of ore that are more or less distinct. One contains principally lead and practically no other metal, and the other carries lead, with a considerable quantity of nickel, cobalt, and copper. It is possible in mining to keep these ores separate, which would result in a considerable saving in the metallurgical reduction of the ore. The crude ore containing lead, copper, cobalt, and nickel as it comes from the mine is concentrated, and from 375 to 400 tons of ore are treated per day, producing 19 to 20 tons of lead concentrates, containing 70 to 75 per cent lead and from 8 to 10 tons of sulphide concentrates, which average approximately 8 per cent of combined copper, nickel, and cobalt and about 20 per cent lead. A sample of these sulphide concentrates was assayed, with the following results:

Partial analysis of nickel-cobalt sulphide concentrates from Fredericktown, Mo. [a]

Copper	6.23
Lead	16.08
Nickel	2.53
Cobalt	2.26

These concentrates are smelted in a lead blast furnace to lead and first matte, which contains the nickel, cobalt, and copper and a small quantity of lead. This first matte is then roasted in an inclined, long-hearth, reverberatory furnace and smelted in a

[a] Ledoux & Co., analysts.

small blast furnace to second matte. It is then further roasted and smelted to third matte, which contains about 18 per cent copper, 24 per cent nickel, 12 per cent cobalt, 10 per cent iron, and 10 per cent lead. Most of the lead in the first matte is caught in dust chambers and is returned to the blast furnace. On account of the tendency of the cobalt to follow iron into the slag, it is not possible to make the third matte of higher grade. When the slag from the third matte goes over 1 per cent of cobalt, it is returned to the lead blast furnace and the cobalt is recovered in first matte. A refinery has been erected for treating this matte, but it was not put in operation in 1905. It is now expected to make a test run during the spring of 1906 to determine whether this matte can be refined by the wet process. All the nickel and cobalt ore in this vicinity is very similar and whatever process is worked out for its treatment at one place will be adaptable to the ore at others. None of the companies operating in this section ship any matte or produce any nickel or cobalt, although all of them obtain a good many tons of sulphide concentrates and some obtain a number of tons of matte.

Idaho.—The deposits of nickel and cobalt ore in Lemhi County, Idaho, to which references have been made in the reports for 1902 and 1903, and from which 60 tons of ore were shipped in 1903 as a sample, made no production in 1905. In a recent letter Mr. James W. Caples, of Glasgow, Mo., states that the cobalt ore occurs in a chloritic schist, the cobalt mineral being cobaltite.[a] An average of several analyses of this mineral is as follows:

Average analysis of cobaltite from Lemhi County, Idaho.[b]

Nickel and cobalt	40
Arsenic	40
Sulphur	20

The ratio of cobalt to nickel was 8 to 1. Samples of the ore that were analyzed varied from 6 to 24 per cent cobalt and nickel, from 40 cents to $2 per ton in gold, and from a trace to eight ounces per ton in silver. These samples were obtained from 18-inch and 6-inch veins. There are a series of veins containing nickel and cobalt cutting through a chloritic schist and varying from 6 inches to 20 or more feet in width. The wider ones, however, contain a much lower per cent of cobalt and nickel. A 20-foot vein which was sampled carries 1 per cent of cobalt and nickel, while the 18-inch vein, which was the richest one examined, contains 20 per cent or more of cobalt and nickel. The 6-inch veins carry from 6 to 10 per cent of cobalt and nickel. The outcrops of these veins can be traced from 4,500 to 6,000 feet. According to Mr. Caples, the district affords abundant supplies of water and timber, and the deposits are ideally located for mining operations.

Oregon.—The presence of deposits of nickel and cobalt ore in Oregon has been known for many years, and there has been a certain amount of development work undertaken. As yet, however, none of these deposits have made any very large production or become factors in the nickel or cobalt market. There are two deposits of more or less importance which contain nickel and cobalt ores of decidedly different character. One of these deposits, which contains the nickel in the form of silicate, probably as the mineral garnierite, is located near the village of Riddles, in the southern part of Douglas County. The nickel mineral occurs as small seams in the basic magnesian (peridotite) rock and represents the concentration of the nickel content that has been leached from the original peridotite rock during its alteration or decomposition. The seams carrying the nickel vary very greatly in width and are more or less intermixed with barren rock. The ore in these seams carries a rather high percentage of nickel oxide, but the material that would have to be taken out in mining this material as an ore would reduce the metallic content of the material

[a] Personal letters, August 15 and December 18, 1905.

[b] J. W. Caples, analyst.

mined very greatly. An analysis made of selected samples of ore from these seams gives the following results: [a]

Analysis of nickel ore from Riddles, Douglas County, Oreg.

	1.	2.	3.
Loss at 110° C	8.87	6.63	7.00
Loss on ignition	6.99	....	....
Al_2O_3 and Fe_2O_3	1.18	1.38	1.33
SiO_2	44.73	48.21	40.55
MgO	10.56	19.90	21.70
NiO	27.57	23.88	29.66
Total	99.90	100.00	100.24

In developing these deposits no deep mining has been undertaken, and simply surface work is represented; thus little or nothing is known regarding the depth to which the nickel ore extends.

The other deposit of nickel and cobalt contains the ore in the form of the arsenide, probably as the mineral smaltite, and occurs near Comer, Grant County. The ore carries a considerable percentage of cobalt with a much smaller percentage of nickel, but also considerable gold and some silver. On account of the large amount of gold the ore has attracted a great deal of attention, and the property is now being developed. A concentrating plant is in process of erection, and all the concentrates will be shipped. A complete analysis of this ore by Dr. H. H. Nicholson was given in the report for 1904.[b] During the year 1905 development work was continued, and now on the Standard vein a drift of 1,000 feet has been run, which has a vertical depth of nearly 500 feet. Ore is reported running as high as $300 to $500 in gold and 20 to 30 per cent in cobalt. A small quantity of the richer ore was shipped after hand cobbing; there was also a small quantity of the ore concentrated; but no regular shipments have as yet been made, and none will be made until the completion of the concentrator.

USES.

In the report for 1903 the uses of metallic nickel and nickel alloys were taken up and described in detail, the largest use of this metal being in the manufacture of nickel and nickel-chromium steels, the greater part of which is employed in the manufacture of armor plate. New uses, however, are steadily being found for nickel, and experiments are constantly being made to determine for what other purposes nickel can be used to advantage, so as to increase the demand for this metal. In this country the producers of nickel are urging its use for coinage purposes. At the present time the United States is making a 5-cent piece out of an alloy of 75 per cent copper and 25 per cent nickel. There are certain advantages, however, in the use of pure nickel for this coin, which have been summarized briefly by Mr. Albert Ladd Colby as follows: [c]

1. Greater resistance of the nickel coin to wear, so that the imprint lasts much longer than with alloy coins.
2. Maintenance of their bright, attractive color and appearance in comparison with the objectionable change of color occurring in time in alloy coins containing much copper.
3. Increased scrap value of the pure nickel coins when finally taken out of circulation over the scrap value of an alloy coin.

[a] Barlow, A. E., analyst, Ann. Rept. Geol. Survey Canada, part H, vol. 14.
[b] Mineral Resources U. S. for 1904, U. S. Geol. Survey, 1905, p. 314.
[c] The Iron Age, April 6, 1905, p. 1175.

4. Extreme difficulty in counterfeiting, as the more powerful presses and machinery necessary to make a nickel coin than required for any alloy coin render secrecy in counterfeiting pure nickel coins practically impossible.

5. To the above may be added the fact that if alloy counterfeiting was attempted on account of the advantages of lighter presses, the counterfeit coin could be at once detected from the pure nickel coin from the fact that it is not attracted by a magnet, as is the case with pure nickel.

CHROMIUM.

SOURCES OF SUPPLY.

The deposits of chromium ore in European and Asiatic Turkey have for many years practically controlled the market for chrome ore, but the rapid expansion of the chrome-ore industry of New Caledonia has been having a very noticeable influence upon the general condition of the chrome market. The United States obtains its principal supply of chromite from Asiatic Turkey; but since the development of the new Caledonia deposits it has been obtaining a certain quantity from this latter locality, and the increase in the production of this mineral from the latter country will have a tendency to reduce somewhat its price on the New York market. In addition to these two countries, chromite is mined in much smaller quantities in Russia, India, Australia, Greece, Canada, and Newfoundland. The United States imports small quantities from Newfoundland and Australia.

Although the mineral chromite occurs widely distributed through the southeastern section of the United States, associated with the basic magnesian rocks, there are but few localities where it is found in sufficient quantity to become an ore of chromium. Many of these localities are at such distance from railroad transportation that it has been impossible to work them commercially. There is one locality near Burnsville, Yancey County, N. C., which, with the extension of the proposed line of the Southern Railway from Asheville to Burnsville, should become available. The prospect work that has been done at this locality indicates that a considerable quantity of chromite will be found.

The largest use of chrome ore is in the form of the ferrochrome alloy, and the metal chromium is used in the manufacture of chrome steel, which in turn is used in the manufacture of armor plate, usually in combination with nickel as a double ferronickel-chromium alloy. Another extensive use of this mineral is in the manufacture of chromium salts for pigments. It is also used to some extent in the manufacture of chrome brick, which are used in smelting furnaces and in open-hearth steel furnaces. The crude ore has also been used to line copper furnaces. A considerable quantity of the ore mined in California during 1905 was used for this latter purpose.

TUNGSTEN.

SOURCES OF SUPPLY.

A reliable and constant supply of tungsten minerals is desirable and of considerable importance, considering the large increase in the demand for the metal tungsten for use in the manufacture of high-speed tool steel and of hardened steel for armor plate and heavy guns. As is indicated by the large increase in the production of tungsten during 1905, the demand for this metal is increasing rapidly, and there is now a regular market for it in this country and abroad. In order to satisfy this demand it is necessary that available sources of supply should be known. At the present time there is but one district in the United States that is being developed as a business proposition and on a large scale, and that is the Boulder County, Colo., district, which has been described in detail by Mr. Kirby Thomas,[a] reference to which is made further on.

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[a] Mining World, July 8, 1905.

There are numerous localities throughout the United States where tungsten minerals have been found, but there are only a few thus far known that give promise of containing the metal in quantity. Only small quantities of ferrotungsten alloys or tungsten salts are imported into the United States, because, at the present time, the European markets utilize practically all of the tungsten that is produced in foreign localities, largely in Australia and Peru. The extent of the Australian deposits warrants their development on a larger scale, and if this is done it is not improbable that a sufficient supply of ore would be obtained to permit of a certain portion of it being shipped to the United States. For the present, however, the United States will have to look within its own borders for its sources of supply of tungsten.

The price of tungsten ores has advanced very rapidly during the last few years, and whereas formerly tungsten concentrates containing 60 per cent WO_3, were valued at from $2 to $3 per unit, they are now worth from $5 to $6 per unit, and it is not improbable that a price at $6 per unit may be maintained. The word unit as used here means 1 per cent of a ton. There has been some attempt made to bring under one control all of the commercial tungsten deposits of the United States, but so far this has not been done.

OCCURRENCES.

In the report for 1904 the general occurrences of tungsten ores were discussed and detailed descriptions were given of the Arizona, Nevada, and South Dakota deposits. During the past year there has been considerable prospecting for tungsten ores and a number of new localities have been discovered, at some of which in Montana and California, ore was produced during 1905.

Colorado.—The principal sources of supply of tungsten ore in Colorado are the deposits in Boulder County. The ore has been found in a portion of the county which lies between Boulder and Nederland and can be roughly divided into a district lying between North Boulder and Middle Boulder creeks; the Gordon Gulch district; the Nederland district; the Eagle Rock district, lying on Boulder Creek; the Beaver Creek district, north of Rollinsville; and the Bummer Gulch district. This county has been pretty thoroughly prospected for tungsten ore, and no new localities have been recently located. As described by Mr. Thomas [a] the ore is found in fissure veins, like the occurrence of gold and silver ores. The tungsten mineral is practically unaltered at the surface, and is found in ore shoots as other minerals are. It sometimes occurs in considerable masses of nearly pure wolframite, but ordinarily it acts as a cementing material of the brecciated vein or country rock, in which case it is necessary to concentrate the ore before marketing it. The ore has thus far been mined to a depth of only 200 feet, but as the veins are strong, there is no reason known why they should not continue to considerable depth without any particular change in the character of the ore or its abundance.

In San Juan County a certain quantity of hübnerite, the manganese tungstate, is mined.

Montana.—A deposit of scheelite has recently been discovered in the western part of Missoula County, Mont. The property had been worked for gold, and the scheelite, which occurs as a gangue mineral, interfered quite seriously in concentrating for gold. The mine is reported as a paying proposition for gold, but in subsequent work a method will be devised for saving the scheelite as a by-product. During 1905 considerable scheelite was mined and shipped.

Washington.—The principal tungsten deposits in Washington are in the vicinity of Deer Trail, Stevens County. There are a number of claims that have been located on deposits carrying tungsten minerals, and some of these have been developed to a considerable extent, sufficiently to show that the tungsten occurs in large quantity.

[a] Thomas, Kirby, Mining World, July 8, 1905.

Before the ore can be shipped, however, it is necessary for it to be concentrated. As yet there has been no concentrator erected in this district and therefore very little of the tungsten minerals has been shipped, not over a few carloads as a trial shipment.

Idaho.—Development work was carried on during 1905 on property near Murray, Shoshone County, Idaho. No tungsten ore was produced beyond that obtained in running a tunnel in developing the property. The operating company expects in the near future to erect a concentrating mill, when it will begin to ship concentrates.

California.—Scheelite has been found in considerable quantity in San Bernardino County, Cal., near Randsburg, Manvel, and Johannesburg. During 1905 considerable ore was shipped from these localities, principally for exportation. These properties are being thoroughly developed and preparations made to produce the mineral on a large scale.

Nevada.—The Nevada deposits have been described in detail in previous reports, and although there was considerable tungsten ore mined during 1905, there was none shipped or concentrated, principally on account of the distance of this deposit from the railroad. Some specimens of high-grade wolframite have been found about 40 miles south of Lovelocks, Humboldt County, Nev., but little work has been done, however, to develop this property, and nothing definite is known regarding the extent of the ore.

Arizona.—The tungsten deposits in the Dragoon Mountains of Arizona were not very extensively operated during 1905. There were quite a number of small producers in this district who shipped their ore to Primos, Pa.

Another tungsten locality in Arizona that has been developed to some extent is near Owens, Mohave County. The locality is 80 miles south of Kingman and 12 miles east of Big Sandy River, in the Aquerra Range. The development work consists of an open cut, 70 feet long and 30 feet deep in its face, which follows a vein 8 feet wide. The wolframite occurs in masses and crystals from 1 ounce to 20 pounds in weight. This property, which consists of twelve claims, has outcrops of the vein ranging from 4 inches to 8 feet in width. There was a small shipment of ore made from this property in 1905, and the owner writes that he will develop the property extensively during the present year. The concentrates average 64.5 per cent tungstic acid.

Other localities.—The scheelite deposits near Trumbull, Conn., Neihart, Mont., and Baker City, Baker County, Oreg., were not operated during 1905. In a copper mine near Holmes, Wyo., a small stringer of wolframite was encountered 800 feet in the tunnel. This was assayed by the State chemist of Wyoming, who found it to contain 52 per cent WO_3. No special work has been done to determine the extent of the tungsten ore.

MOLYBDENUM.

Although there continues to be a good many inquiries for sources of supply of molybdenum ores, the actual demand for ores of this metal is not large and, as far as can be determined, did not increase to any great extent during 1905. In the United States there was a small production of the molybdenum ores molybdenite and wulfenite during 1905, principally from Arizona. Some of the properties which were described in the report for last year were developed to some extent, but none of the ore produced or mined was placed on the market as far as could be determined. There was no discovery of new deposits of molybdenum minerals in this country reported during 1905. There are, however, considerable quantities of this mineral mined abroad, principally in Norway and Australia. Ferro-alloys of this metal have been made in this country at Primos, Pa., and at Kanawha Falls, W. Va. Perhaps the main reasons for this lack of increase in the demand for molybdenum minerals are the fact that the properties which it imparts to steel are somewhat similar to those of tungsten and that its main use is in the manufacture of a high-speed tool steel, for which tungsten is also used. As the supply of tungsten ores seems abundant, it may be some time before there will be any material increase in the demand for molybdenum ores.

The known localities in the United States and those that have been recently discovered in Canada, New Zealand, and other foreign localities indicate that there is a sufficient quantity of this mineral in sight to supply a very large increase in the present demand for it.

VANADIUM AND URANIUM.

The demand for vanadium and uranium for steel-hardening purposes is very limited, and what little production there was of minerals containing these metals in the United States during 1905 was shipped to Hamburg, Germany. No new deposits of these metals were discovered or developed during 1905.

A considerable quantity of vanadium and uranium minerals is mined abroad, and much of the former is used in the manufacture of ferro and nickel vanadium alloys. An interesting article has recently appeared by Mr. J. Baxeres de Alzugaray on the "manufacture and metallurgy of ferrovanadium." [a] In this article attention is called to the fact that vanadium was unknowingly used for hardening steel previous to 1830 by the Swedes. The iron produced from the ores of the Tarberg mines was noted for its great ductility, and in 1830 it was shown by Sefstrom that this property was due to the vanadium that the iron contained. In 1879 and 1880 De Alzugaray obtained a ferrovanadium alloy, but little or no attempt was made to utilize this alloy in the manufacture of a special steel until about 1896, when several French steel works made some tests to introduce vanadium into steel. These were not commercial successes. Experiments, however, were continued by both French and English steel works, which resulted in the manufacture of vanadium steel that has been used commercially. Vanadium steel manufactured at Langley, South Wales, England, was used for spars in Sir Thomas Lipton's racing yacht *Shamrock III* and for the German Emperor's sailing yacht *Meteor.* [b]

Although there are a number of companies manufacturing ferrovanadium both in France and England, there is still but a small quantity of this alloy used in the manufacture of vanadium steel. The ores from which vanadium is obtained are carnotite and vanadinite. M. Herrenschmidt, in a paper presented to the Académie des Sciences, Paris, [c] describes the method used at the works of Bas Coudray at Le Genest (Mayenne), France, for obtaining vanadic acid from the mineral vanadinite (vanadate of lead):

> The mineral is melted in a reverberatory furnace with sodium carbonate and coal. By this process is formed metallic lead, containing the silver of the ore, and a slag which contains vanadate, aluminate, and silicate of soda, and oxide of iron. In order to render this slag soluble in water it is melted in a reverberatory furnace and air is blown into it in order to completely peroxidize the vanadium. The mass is then dropped into boiling water in order to granulate it and is then washed. After three washings the residue, which is composed of alumina, silica, and oxide of iron, does not contain more than 2 per cent of vanadic acid. From each ton of ore 280 kilograms of this residue are obtained; consequently 95 per cent of the vanadic acid contained in the ore is recovered.
>
> In order to remove the silica from the impure sodium vanadate, the solution is evaporated to the consistency of sirup and sulphuric acid (66°) is added. By this operation vanadic acid and sulphate of soda are formed, but all the vanadium is not precipitated. More of the original solution of the impure vanadate is then introduced, and after energetic stirring the mixture is introduced into a filter press, where the silica is entirely precipitated and the vanadium goes into solution. The filtered solution is then evaporated to dryness in order to get rid of the excess of sulphuric acid, and the residue is washed. Vanadic acid of 92 to 95 per cent purity is thus produced.

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[a] Min. World, June 24, 1905, p. 659.

[b] Ibid.

[c] Jour. de l'Electrolyse, December 1, 1904; and Min. Mag., April, 1905, p. 363.

A ferrovanadium alloy, containing from 45 to 55 per cent of vanadium, is manufactured in England. The works at Bas Coudray produce a ferrovanadium containing 33 per cent of vanadium and a nickel-vanadium alloy containing from 18 to 25 per cent vanadium. The works at Llanely, South Wales, are producing a ferrovanadium alloy containing from 23 to 30 per cent vanadium. At Essen-Ruhr, Germany, a ferrovanadium alloy, containing 30 per cent of vanadium, is made. All these alloys are very pure and free from phosphorus and sulphur.

TITANIUM.

The use of titanium in the manufacture of a special steel has not yet assumed any great importance, although experiments are continually being made as to its value for this purpose, and a number of companies are making ferrotitanium alloys. Practically all of the titanium that is produced in this country is in the form of rutile and is used in the form of the oxide for the manufacture of artificial teeth and for coloring porcelain; it is also used as a mordant in dyeing leather. It is nearly all obtained from the mines in Nelson County, Va.

TOTAL PRODUCTION OF STEEL-HARDENING METALS.

During 1905 the total production of steel-hardening metal ores and concentrates amounted to 922 short tons, valued at $288,836, as compared with 1,004 short tons, valued at $259,620, in 1904, a decrease of 82 tons in quantity but an increase of $29,216 in value. Of the 1905 value, over nine-tenths was due to the production of tungsten ores. The States producing these ores in the order of the value of their production, together with the metallic ore mined, were as follows: Colorado (tungsten, uranium, and vanadium), Montana (tungsten and molybdenum), California (tungsten and chromite), Arizona (tungsten and molybdenum), Virginia (titanium), Oregon (cobalt and nickel), and South Dakota (tungsten). In the following table is given the production in the United States of the ores of steel and iron hardening metals for the years 1903 to 1905, inclusive:

Prdouction of ores of steel-hardening metals in the United States, 1903–1905, by metals.

[Short tons.]

Mineral.	1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Chromium	168	$2,250	138	$1,845	25	$375
Molybdenum	795	60,865	14	2,175	90	19,410
Nickel and cobalt	[a] 661	273,900	[b] 23	54,000		
Titanium	....	....	44	7,000		
Tungsten	292	43,639	740	184,000	803	268,676
Uranium and vanadium	30	5,625	45	10,600	4	375
Total	1,946	386,279	1,004	259,620	922	288,836

[a] Nickel and cobalt oxide contents of 3,600 tons of low-grade matte, not refined in 1904.
[b] Combined metals.

PRODUCTION OF NICKEL AND COBALT IN UNITED STATES.

During the last ten years the main supply of nickel and cobalt produced in the United States has been obtained from mine La Motte, Missouri, as a by-product in lead smelting. Besides this there have been small quantities of nickel ore obtained from Idaho, Oregon, and North Carolina. During 1905, however, there was no actual production of any metallic nickel or cobalt oxide, and there was only a very small quantity of nickel and cobalt ore reported sold. There was little or no development work done on any of the nickel deposits, although there was some work done on the cobalt deposits of Oregon. At mine La Motte there was considerable matte obtained which carries a small percentage of nickel and cobalt, but none of this was refined or sold during the year. In the following table is shown the production and value of nickel obtained from domestic ores from 1887 to 1905, inclusive:

Production of nickel from domestic ores in the United States, 1887–1905.

[Pounds.]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1887	205,566	$133,200	1897	23,707	$7,823
1888	204,328	127,632	1898	11,145	3,956
1889	252,663	151,598	1899	22,541	8,566
1890	223,488	134,093	1900	9,715	3,886
1891	118,498	71,099	1901	6,700	3,551
1892	92,252	50,739	1902	5,748	2,701
1893	49,399	22,197	1903	114,200	45,900
1894	9,616	3,269	1904	24,000	11,400
1895	10,302	3,091	1905	(a)	(a)
1896	17,170	4,464			

[a] Ore sold included in total production of steel-hardening metals.

The quantity of cobalt oxide obtained from domestic ores mined in the United States from 1869 to 1905, inclusive, is given in the following table:

Production of cobalt oxide in the United States, 1869–1905.

[Pounds.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1869	811	1882	11,653	1894	6,763
1870	3,854	1883	1,096	1895	14,458
1871	5,086	1884	2,000	1896	10,700
1872	5,749	1885	8,423	1897	19,520
1873	5,128	1886	8,689	1898	6,247
1874	4,145	1887	[a] 18,340	1899	10,230
1875	3,441	1888	8,491	1900	6,471
1876	5,162	1889	13,955	1901	13,360
1877	7,328	1890	6,788	1902	3,730
1878	4,508	1891	7,200	1903	[a] 120,000
1879	4,376	1892	7,869	1904	[a] 22,000
1880	7,251	1893	8,422	1905	(b)
1881	8,280				

[a] Including cobalt oxide in ore and matte.
[b] Ore mined included under total production of steel-hardening metals.

Although there was only a very small production of nickel ore in the United States during 1905, there was a considerable quantity of matte and ore refined, which was imported from Canada and New Caledonia. The nickel obtained from this source is very much in excess of the quantity consumed in the United States, and there is therefore a large export of the metal.

FOREIGN PRODUCTION OF NICKEL.

Nearly all of the nickel ores produced in the world are obtained from Canada, from deposits in New Caledonia controlled by France, Germany, and the United States, and from deposits in Norway controlled by Germany. In the following table is given the production of nickel by these countries from 1889 to 1905 as far as statistics can be obtained. In comparing this table with that of 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, 1889–1905.[a]

Year.	Canada.		France.		Germany.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Metric tons.*		*Metric tons.*	
1889–1900	47,832,049	$20,910,417	15,139	$10,011,795	11,822	$6,807,704
1901	9,189,047	4,594,523	1,800	1,440,000	1,660	1,162,288
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	1,945	1,374,774
1904	10,547,883	4,219,153	1,500	996,459	2,333	1,643,339
1905	18,876,315	7,550,526	....	....	....	....

CANADIAN PRODUCTION OF NICKEL.

At the present time practically all of the nickel used in the United States is obtained from matte imported from Canada and from ore imported from New Caledonia, the former furnishing by far the larger quantity. As we are so dependent upon Canada for our supply of nickel it is of special interest to the users of the metal in the United States to know something regarding the production of nickel ore in that country, 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 during the last five years:

Production of nickel in Canada, 1901–1905.[a]

Year.	Ore produced.	Ore smelted.	Matte obtained.	Nickel in matte.
	Long tons.	*Long tons.*	*Long tons.*	*Pounds.*
1901	326,945	270,380	45,134	9,189,047
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	10,547,883
1905	277,766	251,421	17,388	18,876,315

[a] As reported by the section of mines, geological survey, Canada.

As is seen from this table there was a large increase in the production of ore and also of nickel, which is represented by nickel in matte in 1905 as compared with 1904. There has been an almost constant increase in the production of nickel from Canada since 1896, except for 1904, when there was a falling off in the production of nickel of approximately 2,000,000 pounds. There has been a decided variation in the production of matte, due to the improved metallurgical processes for smelting the ore,

[a] There should be added the production by England from New Caledonian ores of 1,310 metric tons in 1902, 1,650 tons in 1903, and 2,200 tons in 1904, as reported in the twelfth annual issue of "Comparative Statistics," compiled by the Metallgesellschaft, etc., Frankfort on the Main, 1905.

which has resulted in a better quality of matte containing a much higher percentage of nickel.

Of the nickel produced in Canada in 1905, 16,036,465 pounds in matte were shipped to the United States, as compared with 9,204,961 pounds in 1904, and 1,281,594 pounds were shipped to Great Britain, as compared with 2,028,908 pounds in 1904—a large increase in the exportation to the United States and a decrease in that to Great Britain.

IMPORTS OF NICKEL AND COBALT OXIDE.

During 1905 there was a considerable increase in the quantity and value of the nickel compounds and matte imported into the United States as compared with the year 1904, which was due to the very large increase in the quantity of nickel matte imported from Canada. The total quantity of nickel compounds of all kinds imported into the United States in 1905 was 31,072,206 pounds, valued at $1,962,131. As compared with the importation in 1904 of 19,739,315 pounds, valued at $1,121,491, this is an increase of 11,332,891 pounds in quantity and of $840,640 in value.

The total importation of cobalt oxide in 1905 amounted to 70,048 pounds, valued at $139,377. In the tables which follow are given the importation of cobalt oxide and of nickel products into the United States from 1901 to 1905, inclusive:

Cobalt oxide imported and entered for consumption in the United States, 1901–1905.

[Pounds.]

Year.	Oxide.		Year.	Oxide.	
	Quantity.	Value.		Quantity.	Value.
1901	71,969	$134,208	1904	42,354	$86,925
1902	79,984	151,115	1905	70,048	139,377
1903	73,350	145,264			

Nickel imported and entered for consumption in the United States, 1901–1905.

[Pounds.]

Year.	Nickel, nickel ore and matte, nickel oxide, alloys of nickel with copper, etc.	
	Quantity.	Value.
1901	117,364,337	[a] $1,849,620
1902	33,942,710	[a] 1,437,649
1903	36,217,985	[a] 1,493,889
1904	19,739,315	[a] 1,121,491
1905	31,072,206	[a] 1,962,131

[a] Includes $2,498 worth of manufactured nickel in 1901, $30,128 in 1902, $37,284 in 1903, $2,950 in 1904, and $3,291 in 1905.

EXPORTS OF NICKEL.

As has been stated, by far the larger part of the Canadian production of nickel matte is imported by this country, where it is refined. Thus there is produced in this country a much larger quantity of nickel than is required by the domestic consumption, and consequently there is a considerable quantity of metallic nickel exported each year from the United States, none of which, however, is manufactured from ore produced in this country. In 1905 the nickel exported amounted to

9,550,918 pounds, valued at $2,894,700, as compared with 7,519,206 pounds, valued at $2,130,933, in 1904. The quantity and value of the nickel exported from the United States since 1900 are given in the following table:

Exports of nickel oxide and matte from the United States, 1900–1905.

[Pounds.]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1900	5,869,906	$1,382,727	1903	2,414,499	$703,550
1901	5,869,655	1,521,291	1904	7,519,206	2,130,933
1902	3,228,607	924,579	1905	9,550,918	2,894,700

PRODUCTION OF CHROMIUM.

All of the chromium ore produced in the United States during 1905 was from California, but amounted to only 25 tons, valued at $375, as compared with the production of 123 tons, valued at $1,845, in 1904, a decrease of 98 tons in quantity and of $1,470 in value. There is given in the table following the production of chromite in the United States since 1885:

Production of chromite, 1885–1905.

[Long tons.]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1885	2,700	$40,000	1896	786	$6,667
1886	2,000	30,000	1897		
1887	3,000	40,000	1898		
1888	1,500	20,000	1899		
1889	2,000	30,000	1900	140	1,400
1890	3,599	53,985	1901	368	5,790
1891	1,372	20,580	1902	315	4,567
1892	1,500	25,000	1903	150	2,250
1893	1,450	21,750	1904	123	1,845
1894	3,680	53,231	1905	25	375
1895	1,740	16,795			

CANADIAN PRODUCTION OF CHROMIUM.

Most of the chromite produced in Canada is obtained from deposits in the Province of Quebec, with a smaller amount from Newfoundland, and in 1905 this production amounted to 8,575 short tons, valued at $93,301, an increase of 2,501 tons in quantity and of $26,155 in value, as compared with 6,074 short tons, valued at $67,146, in 1904. A large proportion of the chromite produced in Canada was shipped to the United States. In the table following is given the production of Canadian chromite for the last four years:

Production of chromite in Canada, 1902–1905.

[Short tons.]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1902	900	$13,000	1904	6,074	$67,146
1903	3,383	33,830	1905	8,575	93,301

IMPORTS OF CHROMIUM.

Although there is but a small production of chromite in the United States, the consumption requires a large amount to be imported. The greater quantity of this is obtained from Turkey, with smaller quantities from New Caledonia and Canada. Besides chrome ore, there is also considerable chromate and bichromate of potash and chromic acid imported. The total value of all the chromium compounds and ore imported into the United States during 1905 was equal to $752,126, which is $373,211 more than the value of the imports for 1904 ($378,915). Of this amount $4,225 was the value of 59,650 pounds of bichromate of potash, $4,657 the value of 38,553 pounds of chromic acid, and $17,943 the value of 119,847 pounds of chrome yellow. In the table which follows are shown the quantity and value of the chrome ore and chromium products imported for consumption into the United States from 1901 to 1905, inclusive:

Chromate and bichromate of potash, chromic acid, and chrome ore imported and entered for consumption in the United States, 1901–1905.

Year.	Chromate and bichromate of potash.		Chromic acid.		Chrome ore.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Long tons.*		
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
1905	59,650	4,225	[c] 158,402	22,600	54,434	725,301	752,126

[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.
[c] Includes 119,847 pounds of chrome yellow, valued at $17,943.

PRODUCTION OF TUNGSTEN.

There was a considerable increase in the production of tungsten ore during 1905 as compared with that of 1904, and also a general increase in the price paid per ton for the concentrates containing from 60 per cent and over of tungstic oxide (WO_3). There was, however, considerable variation in the price, which in the early part of the year brought $400 per short ton for a 65 per cent concentrate. About July 1 the price was approximately $6 per unit per long ton, and still later in the year the price was $5.50 per unit per long ton. These prices, however, varied more or less with the location of the deposit. The total production of tungsten ore during 1905 was approximately 18,851 short tons, from which there was obtained 803 tons of concentrates valued at $268,676. This is an increase of 63 tons in quantity and of $84,676 in value, as compared with 740 short tons, valued at $184,000, in 1904. The average value per ton of the 1905 production of tungsten concentrates was $335, which is an increase of $86 per ton as compared with the average value per ton of $249 of the 1904 production. A small quantity of the ore was reported as sold in the crude state, but this represented a concentrate obtained by handcobbing. The per cent of tungstic oxide in the ore and concentrates sold varied as reported from 50.49 per cent to 66.28 per cent. The highest price reported as received per ton for concentrates was $400 and the lowest $185. The ore produced consisted of wolframite, hübnerite, and scheelite. Most of the hübnerite was obtained from Arizona, the wolframite from Colorado and South Dakota, and the scheelite from California and Montana.

Besides this production there were two or three tons of tungsten ore and concentrates shipped as a sample run of ore from claims near Deer Trail, Stevens County, Wash.

In the following table are given the production and value of tungsten concentrates for the years 1900 to 1905:

Production of tungsten in the United States, 1900–1905.

[Short tons.]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1900	46	$11,040	1903	292	$43,639
1901	179	27,720	1904	740	184,000
1902	184	34,040	1905	803	268,676

As is seen from this table, there has been a very great advance in the demand for tungsten since 1900 and there has also been a decided increase in the value per ton, notwithstanding the large increase in the production.

IMPORTS AND EXPORTS OF TUNGSTEN.

There have been small quantities of tungsten ores and alloys imported into the United States for a number of years, but as the tungsten ores are admitted free of duty it has been impossible to obtain statistics for them. The imports of ferro-tungsten-chromium alloys in 1905 were valued at $13,525, as compared with $29,439 in 1904, with $18,136 in 1903 and with $7,046 in 1902.

As in the case of the imports, no separate record is kept by the Bureau of Statistics of the exports of tungsten, though some of the concentrates are known to be exported.

PRODUCTION OF MOLYBDENUM.

The production of molybdenum ores in the United States has always been very small, although considerable development work carried on at a number of localities has resulted in the production of a small quantity of molybdenite and a larger quantity of wulfenite. During 1905 the production of molybdenite and of wulfenite was obtained from Arizona and Montana, the total being in excess of the 1904 production of 14½ short tons, valued at $2,175. The value of the molybdenum ores varies from $230 to $430 per ton according to the percentage of MoO_3. The 1905 production is included in the table of total production of steel-hardening metals.

PRODUCTION OF URANIUM AND VANADIUM.

The production of the ores of uranium and vanadium during 1905 amounted to approximately 4 tons, valued at $750, and was obtained from Colorado and Utah. This ore as shipped contained 3.06 per cent uranium oxide (U_3O_8). There was, however, considerable ore mined which was not concentrated at all, but was stored waiting the erection of concentrating mills. The total tonnage of ore taken out as reported to the Survey is 2,081 short tons.

A plant is in process of erection for the treatment of the vanadium sandstone found near Telluride (Newmine), Colo. A plant is projected at Castledale, Emery County, Utah, in which to reduce the uranium ores of the region by a nitric acid process. At Cedar, San Miguel County, Colo., a concentrating mill was recently built for treating the uranium and vanadium ores of that section. With the installation of these mills there should be a large increase in the production of the uranium and vanadium ores, provided a market for them can be maintained in quantity.

IMPORTS OF URANIUM.

There were imported into the United States during 1905 uranium salts to the value of $6,560, as compared with imports valued at $9,024 in 1904, at $13,498 in 1903, and at $12,491 in 1902.

PRODUCTION OF TITANIUM.

The production of titanium was entirely from Roseland, Nelson County, Va. The production in 1905, which was somewhat larger than that of 1904, is given under the total production of steel-hardening metals. On account of the rather small demand for this metal, there can readily be an over-production of the rutile, which is often the case at the Virginia mines and which necessitates the closing down of the plant for a number of months during the year.

PLATINUM.

By F. W. Horton.

INTRODUCTION.

The ever-increasing demand for platinum, coupled with conditions which have greatly reduced the output of the Russian mines, is directly responsible for a phenomenal rise in the price of the metal and indirectly for an increase of production in this country.

The yield of the Russian platinum placers, which usually furnish about 90 per cent of the world's supply, has been greatly reduced by the unsettled condition of affairs in that country. The anxiety felt by platinum dealers during the Japanese-Russian war has not abated since the settlement of international affairs, but, if anything, has increased, owing to the internal troubles which Russia is experiencing. In fact, platinum mining was entirely stopped for a considerable period, and the manufacturers both here and abroad were forced to depend upon reserved stocks of the metal for their supply. Furthermore, before these uprisings, it is said, the large Russian mines were purposely curtailing their production. This reduction of the output is due to the fact that the entire product for a varying term of years was bought up under contract and at prices that now seem ridiculously low. The mine owners, receiving only the fixed price, do not participate in any gain due to rise in value and are therefore not anxious about a large production, but are husbanding the limited resources of their mines until such time as they can dispose of their product to better advantage. Meanwhile the small mines, which, generally speaking, are not hampered by such agreements, are working to their full capacity to take advantage of the stimulated prices; but their entire output is but a small percentage of what is usually produced.

This stringency of supply, together with a greatly increased consumption of the metal in the electrical and chemical industries, accounts for the prevailing high prices.

Prices.—At present (September, 1906) ingot platinum is quoted in New York at $34 per ounce. In December, 1904, the price of the metal advanced from $18.50 to $19.50 per ounce, and early in March, 1905, a further increase to $21 per ounce took place, the ingot metal surpassing gold in value. On April 1, 1905, the price fell to $20.50 and remained firm at this quotation until February 1, 1906, when it jumped to $25 per ounce, where it remained until September. The average weekly quotation for 1905 was $20.34 per ounce for ingot metal at New York.

At the close of the year prices of manufactured platinum were as follows:

Prices of manufactured platinum December 31, 1905.

Heavy sheet and rod, 75 cents per gram, or $23.33 per ounce.
Foil and ordinary sizes of wire, 80 cents per gram, or $24.88 per ounce.
Crucibles and dishes, 85 cents per gram, or $26.44 per ounce.
Perforated ware and special sizes of wire, 90 cents per gram, or $27.99 per ounce.
Cones, $1 per gram, or $31.10 per ounce.
Gas-engine sparking points from 87 cents for A to $1.80 for B.

At the time of writing (March, 1906) these quotations are about 20 per cent higher.

OCCURRENCE.

The geological relations and distribution of platinum and associated metals has been very thoroughly discussed by Prof. J. F. Kemp in Bulletin No. 193 of the United States Geological Survey.[a] This paper is authoritative, but, as it appeared in 1902, a few supplementary notes as to the extension of the then known platinum-bearing areas together with new localities may not be out of place.

UNITED STATES.

The exhaustive tests and examinations of black sands commenced early in 1905 and still being carried on at Portland, Oreg., by the United States Geological Survey, have done much toward placing platinum mining in this country upon a stable footing and developing it into a permanent and profitable industry. Not only have many discoveries of platinum in new localities been made and the limits of the known platinum-bearing areas been extended, but the tests have revealed the fact that there are in this country districts which contain surprising quantities of platinum, and they have also given much valuable data as to the best methods of obtaining it. A description of these methods will be given later.

Platinum is now known to exist in 15 counties in California: Butte, Calaveras, Del Norte, Humboldt, Mendocino, Nevada, Placer, Plumas, Santa Barbara, San Luis Obispo, San Bernardino, Shasta, Siskiyou, Trinity, and Yuba; in 9 counties in Oregon: Baker, Coos, Curry, Douglas, Jackson, Josephine, Lincoln, Linn, and Union; in 8 counties in Idaho: Ada, Bingham, Boise, Elmore, Idaho, Nez Perce, Oneida, and Shoshone; in 4 counties in Colorado: Chaffee, Park, Saguache, and San Miguel; in 3 counties in Washington: King, Skagit, and Whatcom; in 2 counties in Montana: Custer and Granite; in Utah, in Garfield County; in Arizona, in Yavapai County; and in Wyoming, in Albany County. The metal is also found in Alaska and in the gold-bearing sands of the Corozal River, Porto Rico. Isolated occurrences of single nuggets or mere traces of the metals have been found in many other counties in the States mentioned, as well as in four of the eastern States, namely, New York, Pennsylvania, North Carolina, and Georgia. In many of these localities the metal occurs but sparingly. The most promising fields are in the counties of southern Oregon and northern California. Here the metal has been proved to exist in commercial quantities, and, with a proper knowledge of methods of obtaining it, there is no reason to doubt that an output of considerable proportions could be made annually.

The platinum metals are obtained in most cases as a by-product in working gold placers, especially where the gravels are derived from peridotites. The pyroxenites, gabbros, diorites, and sometimes the syenites also furnish favorable associations for the metal. In most cases the platinum is accompanied by chromite, ilmenite, and magnetite sands. In rare instances it is also found in veins, generally associated with the copper sulphides, as in the Rambler Mine, Wyoming, and in North Carolina. It also occurs disseminated, in the native state, through certain basic eruptive rocks, especially the peridotites; and all formations where chromite or serpentine occur in any quantity should be carefully examined for the metal. A very interesting occurrence of platinum in massive chromite from Anacortes, Skagit County, Wash., was discovered by the United States Geological Survey in the course of the tests already referred to. A more detailed description of the occurrence of the metal in the United States will not be attempted, as the subject will be fully discussed in a special report of the Geological Survey.

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[a] Kemp, J. F., The geological relations and distribution of platinum and associated metals: Bull. U. S. Geol. Survey No. 193, 1902.

BRITISH COLUMBIA.

New finds of platinum-bearing gravels have been reported from British Columbia. The newly discovered deposits are in the Cariboo District, and extend from Quesnelle Lake westward to the Fraser River. The gravels, which are of great thickness, lie in ancient river beds, and are of low grades, running only about 15 cents to the cubic yard. A large area of these gravels along the south fork of the Quesnelle River is being worked according to the latest methods. Undercurrents and other appliances are used in connection with sluicing, in order to save the heavy sands and metals which will not amalgamate. Material obtained in this way consists of magnetite, chromite, pyrite, and galena, and carries considerable gold, copper, platinum, palladium, and iridosmine. The gold which is saved in this product has refused to amalgamate, and seems to be coated with oxides of iron and manganese. The platinum metals occur both as free metallic grains and inclosed in the iron minerals, especially in the chromite.

Another discovery of platinum in British Columbia is reported by Mr. R. W. Brock in an article on "Platinum in British Columbia."[a] The metal is found in close association with small quantities of sulphides (pyrite, chalcopyrite, galena, and blende), in a gold-quartz vein at Burnt Basin, 3 miles west of Coryell, in the Grand Forks mining division, Yale district. This occurrence is of an unusual nature and the exact form in which the platinum occurs has not been determined, but it is probably associated with the copper ore. The vein in which it occurs is situated in a greenstone area between two large porphyry dikes, and runs about $3 in gold to the ton.

The occurrence of the platinum metals in the placers of the Similkameen and Tulameen rivers and several of their tributary creeks has been known for many years. These deposits, together with occurrences of the metal in peridotite and serpentines and in an associated granite in the same district, have been thoroughly described by Professor Kemp in his work already referred to.

As to the probability of further discoveries of platinum in British Columbia, it may be said that the basic igneous rocks, such as those which seem to be the source of the platinum in the Similkameen and Tulameen rivers, are widely distributed, not only in the southern part of the province, but as far north as the Atlin district. Areas which seem especially rich in favorable associations for the occurrence of the metal are in the West Kootenai and Boundary Creek districts, which lie some distance to the east of the Similkameen, and discoveries of platinum in these regions would create no surprise.

COLOMBIA.

In Colombia, which ranks second to Russia in the production of platinum, no new discoveries of importance have been made. The platinum-bearing gravels of the one district, El Choco, which embraces the headwaters of the San Juan River, are mined by the natives in a desultory manner, most of the platinum being washed out by hand in bateas. Sluicing is also practiced to some extent. Attempts at dredging on the part of foreign capital have not met with marked success, due principally to the low grade of the gravels dredged.

RUSSIA.

THE URALS.

In Russia the platinum-producing areas have not been materially increased during the last few years, and remain practically as described by Professor Kemp. Active mining is confined to the gravels of the Iss, the Veeya, and the upper Tura, in the Goroblagodat and Bisersk districts, and to the valleys of the Sisim, Visim, Martian,

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[a] Eng. and Min. Jour., Feb. 18, 1904.

Black, and Chaoosh creeks and the headwaters of the Tagil, in the Nijni-Tagilsk region. Besides these two districts, which furnish practically the output of the Russian mines, there are numerous outlying areas in which small quantities of platinum are mined. These are, in a sense, new deposits, as they have not been described until recently. They are of great interest, as they not only extend the known platinum-producing area in the Urals, but furnish, through a study of their deposits, valuable data as to the geological occurrence of the metal.

An excellent description of these smaller deposits, together with a great deal of interesting detail in regard to the platinum region of the Urals in general, is given in an article by Mr. Chester W. Purington on the "Occurrence of Platinum in the Ural Mountains,"[a] from which the following notes are taken:

A brief summary of the newly reported localities is as follows:

1. The gravels of the Petropavlovsk and other creeks which head in the olivine-bearing rocks of Chistop and Choi-Ekba mountains, lying about 100 miles north of the Iss Valley. The production of this region is slight, only about 55 ounces per annum.

2. The valleys of the Immyana and Chirok rivers. The latter is a branch of the Solda, which flows into the Tura below Verkotur. The annual yield is about 1,000 ounces.

3. The Bolshoi and Mali Kamenushka creeks, which lie in the area adjacent to the Nikolai Pavdinsk and Shuvalov grants, the annual preduction amounting to about 3,160 ounces.

4. The Sosnovka and Mali Kosva creeks, which probably derive their platinum from the dunite which outcrops on Kosvinski Hill near the boundary of the Rastessk and Nikolai Pavdinsk grants. The production of these creeks is about 5,800 ounces per annum.

5. The left bank of the Vergran River at Bogostlovsk, about 50 miles north of the last-named locality. The yearly platinum production is from 250 to 500 ounces.

6. The Lobva, Lyalya, and Nyasma rivers in the Vagransk, Znamensk, and Nijni Turinsk districts, to the north of the Iss Valley.

7. At Neviansk, Verk Isetsk, Alapavsk, Bilimba, Sisertsk, Kishtim, and Miask, to the south of the Iss. The annual production is about 400 ounces.

There are many other places in the neighborhood of those already named in which platinum is known to exist, but in such insignificant quantities that the occurrences are not worthy of individual mention.

Whatever the locality of the platinum, it is invariably associated with the olivine rocks, especially with the so-called dunite, which consists of olivine with chromite. This dunite is without doubt the mother rock of the platinum. Mr. Purington says of it:

> Assays of the dunite show the presence of platinum and gold up to the amount of 0.037 ounces per ton. Exhaustive tests have not been made, but they lead to the inference that the platinum is present in the dunite, and that it must contain an enormous amount; and they bring up the question of the possibility of the exploitation of deep platinum mines. There is no doubt that in the midst of the dunite masses there exist some richer areas, favorable alike on account of primary or magmatic and secondary processes, which might be worked advantageously at the present time. It is to be noted that all the localities favorable to the occurrence of platinum are characterized by the presence of dunite. Occurrences of this rock are found for a great length, north and south, along the narrow Ural ridge. To the north of the Iss Valley a strip of dunite occurs uninterruptedly. Platinum makes its appearance wherever dunite is exposed.

As to the possibilities of further discoveries of platinum-bearing gravel, careful prospecting in the northern Urals should disclose new deposits, for the plutonic rocks, including the dunite favorable to the occurrence of platinum, run on the east slope of the mountains to the Arctic Ocean, and this vast region for a distance of

[a] Eng. and Min. Jour., May 5 and 12, 1904.

over 300 miles is totally unexplored. In the southern Urals, recent reports state that rich deposits of platinum have been discovered in the districts of Ougry and Katchkomury; but a great extension of the platinum-producing area in this region is not to be expected, as the ground has already been thoroughly prospected.

OTHER COUNTRIES.

Besides the countries already mentioned as producing platinum, the metal has been found in small quantities in Brazil, in the province of Minas Geraes; in Spain, near Seville; in New South Wales, and in Burma, Japan, Borneo, New Zealand, Tasmania, Sumatra, Honduras, Ecuador, and French Guiana.

Platinum is being obtained in commercial quantities from the Hootalinqua River, Northwest Territory, Canada.

A discovery of platinum in Madagascar has been reported. The metal is said to occur in considerable quantities in the gold-bearing gravels of the River Isonjo, in the province of Farafangana.

In Mexico, small quantities of platinum have recently been obtained in the municipality of Acapulco and the district of Tabares, Guerrero. The metal is also reported as existing in the State of Vera Cruz, in the district of Chocontepec, and at a few other localities in Mexico.

METHODS OF EXTRACTION.

RUSSIA.

In describing the various methods used for the mining and recovery of platinum, those employed in Russia will first be considered, as it is in this country that the greatest quantity of the metal is produced. Then, too, in Russia, the extraction of the platinum is the first and often the sole object of the miner, while in other countries the platinum is generally of secondary consideration, and it is recovered as a by-product of gold washing. The platinum-bearing gravels mined in Russia possess all the characteristics common to the ordinary gold placer. The "pay streak" varies in thickness from 10 to 100 inches, and is generally covered with an overburden of barren gravels from 5 to 50 feet in depth. In cases where the thickness of the overlying gravel is not too great, open mining is done, and all the material extracted is treated; but the usual method is to sink shallow shafts to bed rock and then drift along the pay streaks. There are said to be hundreds of miles of these old drifts and tunnels on the Demidoff estate alone, so that the extent to which this method of mining is practiced may well be imagined.

The bed rock is generally excavated for a depth of from 7 to 14 inches, and the lower part of the overburden is also mined. As in most northern latitudes where placer ground is worked in this way, the shaft sinking and excavation of material takes place during the winter months, and the extracted material is washed in the following summer. The material to be treated is carted in wagons, which contain about 1,500 pounds, to the washing plant, where the load is pulled up an incline to an elevated platform from which it is fed with water into conical trommels directly beneath. The oversize from these screens is thrown away, and the undersize is sluiced, and the sluice concentrates panned in small handpans called "kofchik."

The sluices used are of peculiar construction and have two compartments. The greater part of the metal settles in the first of these and the remaining material then flows into the second compartment, where it is puddled and raked (the stirring being done by women), and more of the platinum is allowed to settle out. After this treatment the material passes into a tailing sluice, whose riffles catch any heavy sand which has escaped the compartments. This sand is liable to contain considerable quantities of platinum, and is cleaned up by hand panning, as are also the concentrates obtained in the two compartments.

An ordinary washing plant of this kind is capable of handling about 125 metric tons of sand in eight hours. The yield of the gravels is variously stated at from 0.05 to 1 ounce per cubic yard.

Most of the platinum from Russia is obtained in the manner just described, but the method is not very efficient, and unless great care is taken considerable quantities of fine platinum are lost in the tailings.

Platinum mining in the Urals, however, has begun to feel the influence of modern methods. Several years ago dredges were shipped in from abroad, and attempts were made to work gravels on the properties of Count Shuvalov and of the Platinum Mining Company. Owing to faulty construction and to their unadaptability to conditions at hand, these dredges proved an entire failure. But the experiments were persevered in and success has finally been attained and has induced a rapid installation of dredges.

At first the dredges were very expensive, as they had to be imported, but now there are several companies in the Ural district that are manufacturing dredges both cheaply and well, and that can supply any demand of the mining companies. The machines closely resemble the modern gold dredge in all their essential features, but have a few modifications which adapt them to the different conditions with which they have to deal.

In describing one of these dredges Mr. Purington says:

The hull drew 5 feet of water, and was well constructed of pine. The digging ladder was of iron, and provided with 46 4-foot buckets having lips of manganese steel. The ladder was designed to dig to 35 feet. Water was supplied by a centrifugal pump. The dredge was moved by winches and cables, no spuds being used. The washing apparatus consisted of a trommel for taking out the coarse material, from which the fines went to two tables with back-to-back arrangements fitted with riffles and mats. The intention was to use no quicksilver in the saving. The stacking ladder was considerably shorter than those generally in use in America. The power was steam, only 50-horse-power boiler and engine being provided. The fuel used was peat. The capacity of the dredge was estimated at 80,000 poods of gravel (about 1,000 cubic yards) per twenty-four hours. The cost of handling the material was estimated at 5 cents (2 doli in fine gold) per cubic yard. The dredge was to be worked by four men on a shift, three eight-hour shifts per day. The cost of the dredge was given to the writer, and was surprisingly low, but as the dredge was not for sale, and the figure given represented the actual cost of building, the publication of it would be unfair to the manufacturers.

There are many localities, especially along the lower Iss and Tura rivers, where conditions appear very favorable for dredging operations.

Whatever measure of success dredging may attain it will not entirely supplant other methods of mining platinum any more than it has supplanted other methods of mining placer gold, but at present the indications point to a considerable development of the industry along this line.

UNITED STATES.

In the United States the mining of platinum is slowly advancing from its hitherto obscure position, and bids fair in the immediate future to occupy a much more important place among the mining industries of the country. This condition of affairs has been brought about largely as a direct result of the tests and experiments conducted by the United States Geological Survey at Portland, Oreg., in connection with the Lewis and Clark Exposition at that place in 1905. These experiments, which were conducted under the immediate supervision of Dr. David T. Day, of the Survey, have succeeded in establishing two facts: First, that the platinum-bearing gravels of this country are of no mean extent nor small value, and, second, that the methods by which the best results in working the deposits may be obtained have been clearly pointed out.

It is with these methods that we are here principally concerned.

Up to the present time the small quantities of the platinum metals produced in this country have been obtained, as already stated, as by-products in washings where the recovery of gold from the gravel or sand was the primary object. In such cases the platinum was caught by the same methods (always excepting amalgamation processes) as were used for the gold, and perhaps no special precautions were taken either to catch it at all or to increase in any way the quantity so obtained. The machines used were the ordinary ones employed in gold washing, such as the "tom," tables supplied with riffles or covered with burlap and cocoa matting, sluices with riffles of different varieties, etc. The heavy concentrates obtained by these machines were further treated, after having been run over amalgamating plates or treated in various forms of amalgamators to remove the gold, by hand panning.

The concentrates thus obtained were still further enriched by removing with a hand magnet any magnetite or other magnetic material, such as nails, pick points, miscellaneous pieces of old iron, etc. In some cases the miner went further and removed the greater part of the other heavy materials, such as chromite, zircon, ilmenite, etc., by blowing in a pan or horn spoon, thus obtaining a final product of quite pure platinum metals.

Even after all this trouble and with the small return which the miner ordinarily gets for the material the process paid. Many managers of placer mines have been convinced for a long time that it would pay them handsomely if they could save the platinum in their gravels by some inexpensive method.

Attempts in this direction have generally taken the shape of specially designed undercurrents, very similar to those used for catching fine gold. These, so far as the catching of platinum is concerned, have not been successful; but their installation has often been profitable by reason of the increased saving of fine gold. The next attempt along this line was to effect the largest possible saving of black sand in the sluices and to pan by hand the entire quantity thus saved in large vats of still water. With expert panners this method will undoubtedly save the larger portion of the platinum in the sand, but it has the objection of being very laborious and expensive.

The experiments of the Geological Survey have conclusively shown that from 95 to 98 per cent of the precious metals, both gold and platinum, contained in the sluice-box sands can be saved on concentrating tables of the Pinder or Wilfley type, such as are used in everyday mill practice; and that in most cases the concentrates thus obtained will represent less than 1 per cent of the total weight of sand fed to the table.

In some cases, where the sand is especially heavy and the precious metals extremely fine, such a high ratio of concentration can not be effected without some loss. In many cases also it has proved good practice to use only a small part of the material at first, and to rerun the concentrates from this preliminary treatment in order to obtain a second and final concentrate. These table tests are described in detail in the report of the Geological Survey, and therefore will not be discussed at greater length here.

The concentrates from the tables are generally rich enough to ship directly to some smelter; but it is not only possible but perfectly practicable to clean them successfully at the concentrating plant. The best method of doing this will, of course, vary greatly according to the character of the concentrates. In general, good results may be obtained as follows:

Treat the material with a weak hand magnet or an electro-magnet (using an extremely low amperage) to remove magnetite, bits of scrap iron, etc. The strength of the magnetic field should be very slight to avoid picking up the more magnetic portions of the platinum, and the material thus extracted should be re-treated to avoid the possibility of mechanical inclusion of fine particles of the precious metals. The magnetic material can then generally be thrown away without loss.

The residue from this treatment should then be passed under an electro-magnet the field of which is strong enough to pick up monazite. In this way it will be divided into a magnetic and a nonmagnetic portion. The former will contain any chromite, ilmenite, garnet, olivine, etc., together with most of the crude platinum.

The latter will, with the exception of zircon, contain only comparatively light minerals, and will consist principally of quartz, which has entered into the concentrates through accident. This product will contain practically all of the gold and iridosmium in the original concentrates and will present no difficulties in cleaning up in a hand pan, as the heavy minerals which would have prevented successful panning have been removed.

Sodium amalgam.—The magnetic portion containing most of the platinum and small quantities of gold should then be treated with a very strong sodium amalgam. This picks up any gold almost immediately and, if the conditions are favorable, all of the platinum. The action of the sodium amalgam on the platinum is not one of amalgamation, but rather one of positive capillarity, by which the platinum grains are wet by the amalgam and retained within its mass. Pure quicksilver and weak sodium amalgam do not, unfortunately, possess this quality, and as sodium amalgam rapidly deteriorates in the presence of water, the material treated should be just sufficiently moist to allow its working, and the time of treatment should not be unnecessarily prolonged. This separation requires considerable experience and skill on the part of the operator. If a strong electro-magnet is not available the original concentrates from the table may be treated with sodium amalgam, but the results obtained in this way do not seem quite so satisfactory.

PHYSICAL PROPERTIES.

Crude platinum consists of an alloy of platinum with iridium, rhodium, palladium, osmium, iron, and often copper and gold. It is almost invariably associated with iridosmium, a natural alloy of iridium and osmium, with which the platinum seems to be combined mechanically. The following table gives analyses of four representative specimens:

Analyses of crude platinum.[a]

	No. 1.	No. 2.	No. 3.	No. 4.
Platinum	51.45	85.50	77.50	76.82
Iridium	.40	1.05	1.45	1.18
Rhodium	.65	1.00	2.80	1.22
Palladium	.15	.60	.85	1.14
Osmium	....	....	2.30	....
Iridosmium	37.30	1.10	2.35	7.98
Gold	.85	.80	....	1.22
Iron	4.30	6.75	9.60	7.43
Copper	2.15	1.40	2.15	.88
Sand	3.00	2.95	1.00	2.41
	100.25	101.15	100.00	100.28

[a] Ann. Chim. Phys., 3d ser., vol. 56, 1859, p. 449.

Sample No. 1 is from Oregon, No. 2 from California, No. 3 from Russia, and No. 4 from Colombia. The analyses are by Deville and Debray.

Outside of its rare occurrence as sperrylite ($PtAs_2$) in copper ores from Sudbury, Ontario; from the Rambler mine, in Wyoming, and from North Carolina, platinum is found under the same conditions as placer gold, and generally in the form of small grains, scales, and nuggets in placer gravels. These scales have a metallic luster and vary in color from a bright silvery white to a dark steel gray. Their specific gravity varies a great deal, according to the percentage of iron they contain, and ranges from 14 to 19. The grains are malleable, sectile, have no cleavage, and possess a hackly fracture. Platinum crystallizes in the isometric system, and in extremely rare cases cubical crystals of it are found, especially where the grains have not traveled far from the mother rock and so have not become worn or beaten out of their original shape. All native platinum is more or less magnetic. The degree of magnetism which it possesses seems to depend directly upon the percentage of iron with which it is alloyed; thus, when the iron content is extraordinarily high, say 18 per cent, the crude platinum may be so magnetic that after treatment with a magnet the fine grains will clot together, each becoming a miniature lodestone. On the other hand, when the percentage of iron is low, say 4 per cent, only a powerful electro-magnet will reveal the fact that the platinum has any magnetic properties.

Crude platinum is not essentially affected by hydrochloric, nitric, or sulphuric acid, but it dissolves in aqua regia and is attacked by free chlorine and bromine. It does not amalgamate with quicksilver, and when cold it is not affected by potassium cyanide. It is fusible with great difficulty, pure platinum melting at 1,750° C.

Associated metals.—The other minerals of the platinum group sometimes found associated with crude platinum are platiniridium, palladium, and iridosmium.

Platiniridium is an alloy of platinum and iridium, in which the iridium attains a proportion as high as 80 per cent. The physical appearance of the mineral closely resembles that of crude platinum, but its specific gravity (22.6 to 23) and its hardness (6.7) are much in excess of those of the latter metal.

Palladium is extremely rare. It occurs both in octahedral crystals and in small grains and scales. It is steel gray in color, and has a metallic luster. Its specific gravity is 11.3 to 11.8, its hardness is 4.5 to 5, and it is malleable, sectile, and ductile.

Iridosmium, the alloy of iridium and osmium already referred to, unlike platinum, generally contains small percentages of ruthenium. It crystallizes in the hexagonal system, but usually occurs in irregularly shaped grains and thin scales. Its hardness is 6.7 and its specific gravity is 18.8 to 21.12. It has a metallic luster and ranges in color from tin white to steel gray. The quantity of platinum contained in the mineral is generally under 3 per cent, and the iron content varies from a trace to 1.5 per cent.

The following table gives the results of a magnetic test made by the writer at Portland, Oreg., in 1905, upon a small sample of crude platinum which contained a large percentage of iridosmium. The sample came from a placer of the Waldo district, southern Oregon. The machine used was a regulation type of the modern Wetherell magnetic concentrator.

Magnetic test of crude platinum containing iridosmium, 1905.

Amperes current.	Percentage extracted.	Amperes current.	Percentage extracted.
Platinum rich in iron:		Platinum poor in iron—Continued.	
0.15	4.0710	2.75	1.7060
.20	1.8070	3.00	1.3440
.50	1.7470	3.25	1.4580
.75	.5509	3.50	.2956
Platinum poor in iron:		Iridosmium very poor in iron:	
1.00	1.4110	3.75	.3225
1.25	1.4650	4.00	.3493
1.50	1.7340	Nonmagnetic iridosmium:	
1.75	1.0480	At 4 amperes nonmagnetic	69.2600
2.00	6.5370	Total	99.9713
2.25	1.8280		
2.50	3.0370		

Manufactured platinum exhibits in general the same physical properties as the crude metal. Its specific gravity is increased to 19.7 for melted metal and to 21.23 for hammered ware. Pure platinum is quite soft, very malleable, and can be drawn into the finest of wire. Its melting point, as already stated, is 1,750° C. Platinum forms readily fusible alloys with lead, tin, bismuth, antimony, and zinc; therefore these metals, or their compounds, should never be treated in platinum vessels. Heated platinum ware is also attacked by free sulphur, selenium, iodine, arsenic, and phosphorus.

Iridium is the hardest known metal. It has a lustrous white color and is about 20 per cent heavier than pure gold, having a specific gravity of 22.4. It is somewhat malleable when hot, but brittle when cold. It fuses at 1,950° C., and, when pure, is insoluble even in aqua regia.

Osmium is the heaviest of the known metals, having a specific gravity of 22.47 to 22.5. It is also practically infusible, with a melting point in the vicinity of 2,500° C. It is easily oxidized when heated to the volatile tetroxide (OsO_4).

Palladium has a specific gravity of 11.4, and approaches steel in hardness. Its melting point, 1,500° C., is the lowest of any of the platinum metals. It is more malleable than platinum, can be welded much more easily, and has a brilliant metallic luster. The one notable property of palladium is its peculiar power to absorb hydrogen, first forming palladium hydride (Pd_2H), which in turn absorbs further hydrogen. At ordinary temperatures palladium foils will absorb about 370 volumes of hydrogen, and if the foil be heated to 100° C. the quantity of hydrogen absorbed will be increased to 650 volumes. Palladium sponge is even more active, and at 100° C. will absorb nearly 1,000 times its volume of hydrogen.[a]

Rhodium is steel gray in color, has a specific gravity of 12.1; it fuses at 2,000° C., and is less malleable and ductile than platinum. It oxidizes at a red heat, but when pure is insoluble in all acids.

Ruthenium is a hard and brittle metal, having a specific gravity of 11.4. It is almost as infusible as osmium, melting at about 2,500° C. It oxidizes slowly at ordinary temperature and very rapidly when heated, forming ruthenic oxide (Ru_2O_3).

PRODUCTION.

The production of platinum in 1905 is reported as 318 ounces, valued at $5,320, as against 200 ounces, valued at $4,160, in 1904.

IMPORTS.

The imports of platinum during 1905 were valued at $2,173,263, as against $1,879,155 in 1904, an increase in value of $294,108. The imports in 1905 were distributed as follows: Unmanufactured, 1,598 pounds ($296,883); ingots, bar sheets, and wire, 6,228 pounds ($1,688,224); vases, retorts, and other apparatus, vessels and parts thereof for chemical uses, $186,742; manufactures of, not specially provided for, $1,414. The imports in 1903 were valued at $2,055,933, in 1902 at $1,987,980, and in 1901 at $1,695,895.

Considering the increased demand for platinum, the gain in importation is slight, but if the high price and scarcity of the metal be taken into account the wonder is that there was not a large decrease in the quantity imported.

USES.

On account of its many valuable physical and chemical properties platinum has a diversity of uses exceeded by no other metal. Its employment is of course restricted by its scarcity and high price, but to many of the arts and sciences it is an indispensable adjunct. The principal consumption of platinum is in the chemical and elec-

[a] Wharton, Joseph, Palladium: Proc. Am. Phil. Soc., vol. 43, No. 177.

trical industries. In the former it is used as dishes, crucibles, cones, anodes, cathodes, retorts, triangles, foil, wire, etc., and as a reagent, especially as platinic chloride ($PtCl_4$). The finely divided platinum known as platinum sponge or platinum black has the property of absorbing large quantities of oxygen, especially when the metal is heated, and of liberating this oxygen again when it is allowed to cool. Hence platinum sponge is made use of as an oxidizing agent in a great many chemical processes, for example, in the Schroeder-Grillo method, for the manufacture of sulphuric acid (H_2SO_4), where 1 kilogram of platinum is consumed for every 10 tons of sulphuric anhydride produced.

In electrical appliances platinum finds numberless uses. It is employed in incandescent lamps, in electric furnaces, in instruments for the measurement of electrical quantities, and as contacts and attachments in electrical machines of almost every description. It is finding a new and extensive use as sparking points for gas engines.

In physics it is used in thermocouples and resistance thermometers.

The riders and small weights used with chemical and assay balances are made of platinum alloyed with a small percentage of iridium.

Silversmiths impart the French-gray finish, so much in vogue at present, by electroplating the silver with a very thin coating of platinum.

Platinum, too, has been used for coinage. In 1828 the Russian mint turned out a considerable quantity of platinum coins; but they were not received favorably and were soon recalled. Spain, at a time when platinum was much cheaper than at present, is said to have debased her coinage with this metal.

Further uses of platinum are to be found in photography, dentistry, pyrography, in the manufacture of surgical instruments, and in jewelry, and its employment in other fields of industry is only precluded by its limited supply.

As to the uses of the other metals which usually occur intimately associated with platinum, that is iridium, osmium, and sometimes palladium, rodium, and ruthenium.

Iridium is used in small percentages as an alloy to harden platinum, thus adding to the durability of articles manufactured from that metal. Alloys in which iridium is present in larger percentages are used in the construction of standards of length and weight and as wire in standard resistance coils. Iridium is also used in making knife edges for delicate balances or other instruments where similar construction is needed. The natural alloy of iridium with osmium, iridosmium, on account of its extreme hardness, is used to point gold pens and as bearings in watches and compasses. The cost of pure iridium is about $30 per ounce.

Until within a few years the presence of osmium in crude platinum was considered a serious obstacle and interfered materially with the sale of the product, as it was both hard to remove and in itself of no use. The recent invention of the "Auer" or osmium lamp, which is a new incandescent electric light using a filament of metallic osmium, has created a considerable demand for the metal. Osmium tetroxide (OsO_4) is employed in staining thin sections of organic tissue in microscopic work. Osmium compounds are also used in the precipitation of bacterial organisms from water and other liquids.

Palladium is employed in the construction of finely divided scales for delicate scientific instruments and in the manufacture of chronometers and watches. It is also used with platinum in the preparation of toning baths in photography.

Rhodium and ruthenium are as yet of no commercial importance.

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ANTIMONY.

By C. C. Schnatterbeck.

INTRODUCTION.

Stibnite, the sulphide of antimony and the chief source of the metal, is widely distributed in the United States, Europe, and Asia. When pure this ore (Sb_2S_3), also called "needle antimony" and "glance" in the trade, contains 71.2 per cent antimony and 28.2 per cent sulphur. It is shiny steel gray in color and soft. The oxidized ore (Sb_2O_3), a dense, heavy white mineral occurring in plenty is of comparatively lower grade and more complex than stibnite. Senarmontite, or oxide of antimony, usually contains from 30 to 65 per cent of the metal as mined for consumption; but the difficulty experienced in treatment has discouraged the demand. Another common ore is kermesite, or red antimony, a mixture of oxide and sulphide, which is mined principally in Italy. Antimonial ochers, found largely in Algeria, Asia Minor, and Borneo, are of some value as a source of the metal. Antimonial lead, produced in quantity by leading refining works, is also an important contributor to the supply of antimony.

The supply of ore marketed continues to be exceedingly small. China for the last five or six years has produced the greatest quantity of ore, but since June, 1904, there has been a heavy falling off in these shipments. This may be explained partly by the manipulation in ore by speculative interests in China and perhaps to a more marked degree by the sudden and unexpected exhaustion of certain mines in that country.

For some time it was believed that the extraordinary demand by Russia and Japan for antimony metal for hardening shot used in the late war was keeping the price up, but in early December the market was higher than when peace was declared. It is clearly evident that the antimony industry is passing through a stage of its history that has been repeated many times.

A peculiarity of the industry is that while antimony ore exists in varying quantity in many parts of the world, three or four countries in turn within the last thirty or forty years have supplied the bulk of the production. Makers of antimony metal and its chemical compounds at one time were dependent upon Portugal for supplies of ore; the Straits Settlements at another period satisfied the demand, and within the last few years it has been China. The current belief is that prices for antimony metal will continue high until deposits have been discovered which can be worked on as large a scale as those furnishing the shipments that have been made from

China. Prospects that Japan, for many years an important factor in the market, will continue to ship appreciable quantities of antimony are not encouraging, as the domestic ore deposits are understood to be exhausted, and supplies from China will not be as plentiful as they have been during the last six years or more.

PRODUCTION.

The United States, although it has good deposits of ore in several of the Western States (deposits are known in the Philippines also), mined no antimony in 1905. Reasons for this are high freights on ore from the place of production to point of consumption, uncertainty of mining, and the difficulties to be encountered in the metallurgical production of the regulus. Consequently the domestic consumption of antimony is satisfied by the metal that is recovered in quantity as a by-product in refining base bullion, which contains from 18 to 20 per cent and even as high as 35 to 40 per cent antimony, and also by imports from various countries. The production of antimony as a by-product and from imported ores in the United States in 1905 amounted to 3,240 short tons, valued at $705,787, as against 3,057 tons, valued at $505,524, in 1904, an increase of 183 tons in quantity and of $200,263 in value. The output in 1905 was the largest in three years, and only twice in the history of the trade was there a larger annual production—in 1900 and 1902.

Production of metallic antimony from domestic and foreign ores and that contained in hard lead in the United States, 1901–1905.

[Short tons.]

Year.	Contained in hard lead. [a]		Produced from foreign and domestic ores.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1901	2,235	$457,150	[b] 403	$82,752	2,639	$539,902
1902	2,904	505,340	[b] 657	129,166	3,561	634,506
1903	2,558	445,092	[b] 570	103,341	3,128	548,433
1904	2,571	[c] 443,598	[d] 486	[c] 61,926	3,057	505,524
1905	2,747	588,354	493	117,433	3,240	705,787

[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] Exclusive of foreign ores imported and reexported.
[c] Estimated from the prices current for the year.
[d] Estimated from the average content of the ore.

IMPORTS.

The greater part of the ore imported free of duty into the United States comes from China, although small lots have been received also from Mexico, where 45 antimony properties, covering 2,087 hectares, were registered with the Mexican treasury department on December 31, 1904. Regulus or metal is imported at a duty of three-fourths of 1 cent per pound from England, Japan, Hungary, and France in the order named. The imports of metal and regulus into the United States in 1905 amounted to 4,941,247 pounds, valued at $431,228, and of crude antimony and ore, 1,970,788 pounds, valued at $53,026. Compared with 1904 there is shown an increase of 1,537,202 pounds, valued at $182,602, in the imports of metal and regulus, and a decrease of 317,730 pounds in quantity and an increase of $2,612 in value of crude antimony and ore. It is of interest to remark that never in the history of the import trade has the total value of imports ($484,254) been so large as in 1905.

Antimony and antimony ore imported and entered for consumption in the United States, 1901–1905.

[Pounds.]

Year.	Metal and regulus.		Crude antimony and ore.		Total value.
	Quantity.	Value.	Quantity.	Value.	
1901	3,640,505	$254,529	[a] 1,682,301	$22,720	$278,066
1902	5,388,739	333,601	[a] 3,129,069	62,968	396,569
1903	4,694,309	260,144	2,714,617	54,316	314,460
1904	4,268,045	248,726	2,488,518	50,414	299,140
1905	4,941,247	431,228	1,970,788	53,026	484,254

[a] Excludes exports.

CONSUMPTION.

Adding the net imports to the production shows that the total consumption of antimony in the United States in 1905 was 5,712 short tons, which, compared with 4,759 in 1904, is an increase of 953 tons, or over 20 per cent. Only twice, in 1900 and 1902, has this consumption been exceeded.

Estimated consumption of antimony in the United States, 1901–1905.

[Short tons.]

Year.	Contained in hard lead.	From domestic ores.	From imported ores and crude antimony.	Imported metal or regulus.	Total.
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
1905	2,747	Nil.	493	2,472	5,712

PRICES.

The domestic antimony market has been affected in 1905 by the scarcity of certain brands of metal and the limited supply of antimonial lead, particularly during the last six or eight months. This situation has been annoying, as the consumption of antimony is growing. Generally speaking, prices have advanced fully 100 per cent during the year, and are considered the high record since 1891. There are six brands of metal on the market, namely, Cookson's, Hallett's, United States, Japanese, Hungarian, and French, and until quite recently Chinese was sold in America.

For the information of miners it may be said that smelters pay for ore according to its content of antimony (determined by a fire assay) and its freedom from impurities, such as arsenic, lead, and copper. Ores carrying less than 50 per cent metal are not marketable at present unless they have other unique features which would facilitate smelting. The smelter usually deducts about 30 cents per ton for sampling and weighing ore. In calculating the value of an ore the basis of quotations for metal in London is used, and should the ore exceed 50 per cent metal a premium is allowed, while for every per cent less a discount is exacted. In early December, 1905, 50 per cent antimony ore was quoted in London at £15 ($72.90) per long ton. The valuation of needle antimony (the sulphide in its purest state) has risen during the year from the equivalent of 2¼ cents per pound to about 7 cents, free on board, at New York.

Prices of antimony at New York, 1901–1905, by months.

[Cents per pound.]

Month.	1901.		1902.			1903.		
	Hallett's.	Others.	Cookson's.	Hallett's.	Others.	Cookson's.	Hallett's.	Others.
January	9¼	8⅜ to 9	10	8 to 8¼	7¾ to 8	8¼ to 8½	7 to 7⅛	6¾ to 6⅞
February	9¼	8¾ to 9	10	8 to 8⅛	7¾	8¼ to 8⅜	7 to 7⅛	6⅝ to 6⅞
March	8¼ to 9¼	8½ to 9	9¾ to 10	8 to 8⅛	7¾	8¼	6¾ to 7	6½ to 6⅝
April	8¾ to 9	8½ to 8¾	9¾ to 10	8 to 8⅛	7¾	8¼	6¾ to 6⅞	6½
May	8¾ to 9	8½ to 8¾	9¾ to 10	8 to 8¼	7¾ to 8	7½ to 8	6¾ to 6⅞	6½
June	8¾	....	9¾ to 10	8 to 8¼	8	7½ to 8	6⅝ to 6¾	6⅜ to 6½
July	8¾	....	9¾	8¼	8	7¼ to 7½	6⅜ to 6⅝	6¼ to 6½
August	8½ to 8¾	8¼ to 8½	9¾	8 to 8¼	7¾ to 8	7 to 7½	6⅜ to 6½	5¾ to 6⅜
September	8½ to 8¾	8¼ to 8½	9½ to 9¾	7¾ to 8	7¼ to 7¾	7 to 7¼	6¼ to 6⅜	5¾ to 6¼
October	8⅜ to 8½	8 to 8¼	9 to 9¾	7½ to 7¾	7¼ to 7½	7 to 7¼	6¼ to 6⅜	5¾ to 6¼
November	8⅜	8 to 8¼	9 to 9½	7⅜ to 7⅝	7⅛ to 7¼	6¾ to 7¼	6¼ to 6⅜	5⅝ to 6¼
December	8¼ to 8⅜	8 to 8¼	9 to 9½	7⅛ to 7⅜	6¾ to 7	6¾ to 7¼	6¼ to 6⅜	5⅝ to 6¼

Month.	1904.			1905.		
	Cookson's.	Hallett's.	Others.	Cookson's.	Hallett's.	Others.
January	7 to 8¼	6¼	5⅝	8¼ to 9¼	9 to 9⅛	7½ to 9
February	8 to 8¼	6¾	6¼	8¼ to 8½	9	7½ to 8
March	8 to 8¼	6⅞	6⅜	8¼	8¼ to 8¾	7⅜ to 7⅝
April	7⅞ to 8	6¾	6⅜	8½ to 9	8½ to 9	8¼ to 8⅜
May	7¾ to 7⅞	6⅝	6¼	9 to 15	8¾ to 14¼	8⅗ to 14
June	7¼ to 7½	6⅜	6	9 to 12	9 to 11½	8⅞ to 12
July	7¼ to 7½	6¾	6	12½ to 14	12½ to 13	12¼ to 14
August	7 to 7¼	6⅝	6	14½ to 17⅜	15 to 16	13 to 16½
September	7	6½	6	13⅞ to 14	13½ to 13¾	12⅜ to 13½
October	7 to 7½	6⅝	6⅛	12¾ to 13½	12½ to 13	11⅛ to 13½
November	7⅜ to 10	7⅜	7¼	13 to 13½	12¼ to 12½	11⅓ to 12
December	9 to 10	8⅛	8⅛	13¼ to 13½	12½	12 to 13¼

PRODUCING COUNTRIES.

It is difficult to collect statistics showing the world's production of antimony, primarily because few foreign government reports are sufficiently in detail to convey an idea of the actual quantity. In France, it is the custom to add the product from Algeria; in Germany, quicksilver is included with antimony; in Hungary, crude antimony and metal are grouped together. But perhaps the most singular thing is that accurate figures showing the output of China, the source of largest supply, are not obtainable, as the empire does not collect mineral and metal statistics. From the most authoritative source—the importers of Chinese antimony—it is learned that the exports from China in the first six months of 1905 amounted to 2,014 long tons, while the last half showed a material decrease. In 1904 the exports from China were 12,037 long tons, as against 7,341 tons in 1903, 10,087 tons in 1902, and 3,633 tons in 1901. A noteworthy incident is the reopening of the antimony mine at Moretons Harbor, Notre Dame district, Newfoundland.

USES.

Undoubtedly the chief use of antimony is for alloying with other metals for the purpose of making a lustrous, hard mixture. Type metal contains from 17 to 20 per cent antimony, in addition to lead and bismuth. Britannia metal is an alloy of 10 per cent antimony and 90 per cent tin. Pewter contains 7.1 per cent antimony, 1.8 per cent copper, 1.8 per cent bismuth, and 89.3 per cent tin, and is employed for certain tableware. Aluminum-antimony alloys are also being made; they are hard, tenacious, elastic, malleable, take a high polish, and resist atmospheric corrosion. Nickel, copper, silver, tungsten, and other metals will readily combine with aluminum and antimony, these alloys being used for special castings. Lead when alloyed with antimony and metallic sodium has unique noncorrosive properties, is strong, and rolls better into sheets and wire. This alloy may be soldered by the ordinary soldering iron with the use of the blowpipe. According to M. Louis H. E. Lacroix, of Pont de Cherny, France, the alloy is made as follows: The antimony is melted in a crucible, and the lead added; the metallic sodium is next introduced, and the whole is then stirred energetically. The mixture, containing 1,000 pounds of lead, 15 pounds of antimony, and 1 pound of sodium, is then cast into molds. Zinc readily unites with antimony in all proportions, forming alloys which are brittle and fusible. When alloyed in equal parts, antimony and zinc are of a bright, sky-blue color, and have the peculiar property of writing on glass. Antimony-zinc alloys are employed in a small way in thermopiles. The various patented antifriction metals used for high-speed machinery contain antimony.

PATENTS.

The attention of inventors seems to be devoted mostly to the discovery of an improved, economic method of recovering antimony from its various ores, and of refining the metal to a high tenor of purity. The preparation of alloys also offers a field for profitable research, and among the minor specialties is antimonial plating. According to United States patent No. 796849 antimony compounds may be recovered from pulverized ore (especially stibnite) by treating it in a heated solution of 2 per cent of caustic soda. The process proceeds in a cycle, the alkaline solution first acting on the ore, then being formed into a carbonate, and then becoming recausticized repeatedly. By another method (Australian patent No. 161776) antimony oxide is prepared from stibnite by treating the pulverized ore with sulphuric acid in the presence of sodium or potassium sulphates, and after allowing the substance to cool, boiling it with water until it is decomposed. Antimony oxide is left, and the acid released is used over again. British patent No. 15295, of 1904, electrolyzes antimony trifluoride in a cell having the impure antimony as anode. Coating metallic articles with antimony by immersing them in antimony powder and heating the mass, is the subject of British patent No. 13579, of 1904.

BISMUTH.

By C. C. Schnatterbeck.

INTRODUCTION.

Interesting features in the bismuth industry in 1905 have been the shipment of ore from a new deposit in California, the resumption of mining on the famous Ballard property in Colorado, and the reduction in the combination's price of the metal in London from 10s. ($2.43) to 5s. ($1.22) per pound. The combination thus reduced its price 50 per cent in 1905. At 5s. per pound in London, the cost in Philadelphia is about $1.28. More attention has also been given to the development of the deposits in Saxony, the most important in the world, as well as to those in Austria, Bolivia, and Australia. For years the world's consumption of bismuth has been met by the celebrated mines in Saxony, where it occurs chiefly at Schneeberg, in the veins which are worked for cobalt ores, and at Altenberg, where the metal is found associated with cassiterite. Quantities of bismuth are also produced as a by-product in smelting lead bullion at Freiberg, Germany. In Austria the principal sources of supply are the gold, silver, and tin bearing ores in Bohemia, where bismuth is also recovered as a by-product in the preparation of uranium oxide at Joachimthal. In Australia bismuth is widely distributed, being associated principally with tin, copper, and iron pyrite, and with the noble metals, notably in New South Wales and Queensland.

Recently there has been developed in Tasmania, New Zealand, what is believed to be an enormous deposit of tin-bismuth-copper ore. Bolivia has long been favorably known as a source of supply of bismuth, the metal occurring with tin, gold, and silver ores, especially at Tasna and Chorolque. Mexico also has deposits of bismuth which may be developed to a greater extent in the near future. In France bismuth has been discovered in quantity with wolfram, pyrite, and phosphatic minerals at Meymac. The Cornwall, England, tin and copper mines have also produced bismuth in small quantity.

Frequently there are discoveries of bismuth-bearing ores which contain from 3 to 5 or 7 per cent metal; these are seldom in a position to be developed profitably, as smelters prefer an ore which will average 10 per cent or more. Sometimes low-grade ores may be concentrated and separated magnetically in a higher metallic content. Consideration of the smelters is also given to the complex nature of a bismuth ore and the difficulty to be experienced in producing the refined metal. The foreign combination holds the secret of treating complex ores, hence its prestige as a monopoly in the bismuth industry may be perpetual. To be sure patents are constantly granted to inventors who have been carefully studying the metallurgy of bismuth, but the combination has so fortified its position by trade agreements, etc., that independent production of the metal is discouraged.

Ordinarily the ore is roasted and smelted in specially arranged crucible furnaces, and the impurities in the bismuth—iron, lead, silver, cobalt, nickel, arsenic, and sulphur—are removed by liquation. If the bismuth carries cassiterite, the roasted tin ore is leached with hydrochloric acid and the bismuth is then precipitated as oxychloride by diluting the solution.

Refined bismuth is a reddish-white metal with a high luster and foliated texture. It is brittle, easily pulverized, and breaks with a well-defined crystalline fracture. Its specific gravity is 9.83, and the metal melts at 264° C.

Little progress is shown in the consumption of bismuth, and only when an extraordinary demand arises, as during the Russo-Japanese war, when bismuth compounds were used for medicinal and surgical purposes, does the trade awaken to the possibilities of expansion. In the United States the consumption of metallic bismuth in 1905 was between 175,000 and 200,000 pounds. Most of this was imported free of duty. Small quantities of bismuth salts for chemical and pharmaceutical purposes have also been imported. It is a fact worthy of note that the import trade has grown over 50 per cent in the last ten years, while the bismuth-mining industry in this country has shown comparatively little progress. This is not because there is a scarcity of bismuth-bearing deposits in the United States, as they have been found in Colorado, California, Nevada, Arizona, and Utah, but it is rather the result of inadequate methods of smelting the metal here. The refined bismuth imported from Great Britain and Germany frequently analyzes over 96 per cent in purity, while crude metal will be 93 to 96 per cent, having as impurities antimony and arsenic or other metals.

Mining for bismuth in the United States is at present centered in Leadville, Colo., where the newly incorporated Ballard Consolidated Mining and Milling Company resumed shipments June 1, 1905, from properties that have heretofore been owned and leased by individuals. The new deposit in California, which early in the year shipped 20 or 30 tons of ore, is situated 55 miles east of Banning. Of late there has been a good inquiry in the market for bismuth sulphide ore, and it would not be surprising if in the near future the metal would be recovered from the immense placer dumps of schirmerite (containing bismuth, silver, lead, and sulphur) in Montana and other western States.

PRODUCTION.

During 1905 the marketed production of bismuth ore in the United States amounted to 24,405 pounds, containing approximately 2,288 pounds of metal, valued at $4,187. The sales in 1904 were 5,184 pounds of ore, valued at $314, showing a large increase in 1905. In 1902 and 1903 there were no transactions. At the end of 1905 there were on hand in bins, unmarketed and not accounted for in production, 10 short tons of bismuth ore, containing about 1,400 pounds of metal; this compares with 83 tons on December 31, 1904.

IMPORTS.

Metallic bismuth to the amount of 148,589 pounds, valued at $318,007, was imported into the United States in 1905, as against 185,905 pounds, valued at $339,058, in 1904, 147,295 pounds, valued at $235,199, in 1903, and 190,837 pounds, valued at $213,704, in 1902. Comparatively little bismuth salt is imported, suggesting expansion in the domestic manufacturing industry.

USES.

The uses of bismuth are fairly numerous, and recently the German and French Governments adopted this metal in place of lead for the cores of rifle bullets. The alloys of bismuth with lead and tin are well known for their easy fusibility, and their property of expanding on solidification. Their fusibility can be increased by adding cadmium. Usually alloys contain from 20 to 50 per cent bismuth, 25 to 50 per cent lead, 4 to 20 per cent tin, and occasionally a little cadmium. There has been further research work on copper-bismuth alloys to determine their physical characteristics, and to decide what percentage of each metal will make the best eutectic mixture. The structure of copper alloys containing 98 per cent or more bismuth resembles pure bismuth. Alloys generally are valued by the market conditions of their constituent metals.

Bismuth salts have been in some demand, and their market prices have been lowered by the change in the position of the metal. Bismuth oxide with boric and silicic acids is used for optical glasses, and to a larger extent for making porcelain colors; and boric nitrate is a good cosmetic, and is also utilized in the compounding of medicine. For medicinal purposes bismuth must be absolutely pure.

TIN.

By Frank L. Hess.

PRODUCTION.

During the year 1905 there was no actual production of metallic tin in the United States, the only production being an insignificant quantity of ore from the placers of Buck Creek, Alaska. There was no output from the lode claims of the York region, Alaska; none from South Carolina, although 18 tons had been washed from the residual placers at Gaffney, in the northern part of that State, in 1904; nor was any production reported from the Black Hills region of South Dakota and Wyoming.

In Alaska the season was exceedingly bad, so that sluicing on Buck Creek was carried on under great difficulty, and this, together with other reasons, resulted in a small showing for the year's work. However, the first really good prospects on Cape Prince of Wales were found during the year, and the possibility of future production is not without hope.

Prospecting was actively carried on in the Lost River Valley of the York region, where larger quantities of tin ore were shown to be present than had been known, and small veins were found at several points in the vicinity of the original discovery.

Small veins of cassiterite-bearing quartz were found in the slates around the head of Buck Creek, and small stringers of cassiterite were also found in granitic intrusions. These, however, hold no great promise as to future production.

From Ears Mountain, 40 miles east of Cape Prince of Wales, specimens of supposed tin-bearing rock have been brought by a number of parties; but, although tin ore has undoubtedly been found there, the minerals taken for cassiterite are, more often than otherwise, either tourmaline or augite. What the extent of the deposits may be is wholly unknown. Some stream tin has been found in the creeks heading on the mountain.

Prospecting for stream tin has been carried on and has shown cassiterite to exist in variable quantities in many of the small streams flowing into Lopps Lagoon, but in most of these streams it would be difficult to get sufficient water for sluicing.

Good prospects are reported as being found in Grouse Creek, below the mouth of Buck Creek. Small quantities of stream tin have been found in a number of other creeks of Seward Peninsula, but nothing so far shown warrants the statement heralded in glowing prospectuses that there is "tin enough in sight to supply the world." [a]

In the Black Hills some prospecting was carried on in both South Dakota and Wyoming, and a small experimental mill was erected at the Etta mine. It is hoped that there will be some output during the present year.

In the South Carolina-North Carolina region, although there was no output, much prospecting and development work has been carried on, especially at Kings Mountain and Lincolnton. At the former place a mill with rolls, jigs, and tables was

[a] A more detailed description of the tin deposits of the York region, by the writer, occurs in Report on progress of investigation of mineral resources of Alaska in 1905: Bull. U. S. Geol. Survey No. 284, 1906, pp. 145–157.

erected; several shafts were sunk to a depth of 40 to 50 feet, and prospecting is being carried on on the old Ledoux properties south of the town. Some concentrates have been obtained.

At the Jones mine, 7½ miles north of the town of Kings Mountain, a small roll mill with two Bartlett tables was erected and a small quantity of concentrates turned out. Some very promising ore has been struck, and prospecting is being carried on at the 100-foot level.

About 1½ miles north of Lincolnton, N. C., extensive prospecting has been carried on, a large number of surface trenches have been dug, some hundreds of feet of drifts driven, and rich ore has been uncovered at a number of places.

At the Ross mine, 1½ miles north of Gaffney, S. C., and but a few miles below the North Carolina State line, good boilers, a hoisting engine, and a pump have been installed, and a shaft 121 feet deep has been sunk. Several hundred feet of drifts have been run on the 65 and the 95-foot levels. A number of tons of ore are upon the dump ready for treatment, and a small quantity has been washed in sluice boxes. The country rock and gangue here is greatly decayed.

At the El Paso, Tex., deposits there have been no notable developments. An article on this occurrence, by G. B. Richardson, appears in the Contributions to economic geology, 1905.[a]

In California some prospecting is said to have been carried on at the old Temescal mines and near Santa Ana, but there has been no resulting production during the year.

No new occurrences of tin are known to have been found in the United States in 1905.

PRODUCTION IN FOREIGN COUNTRIES.

Although complete figures of the output of tin in foreign countries are not at present available, it seems likely that the total was about the same as that of 1904. An estimate of the production for 1905 is given further along in this article.

Malay Peninsula.—The Malay Peninsula still contributes by far the largest quantity, although the output was somewhat less than that of 1904, owing to the exhaustion of many of the placers and to a shortage of labor, said to be due to many of the coolies having gone to South Africa to work in the gold mines. The cost of labor and of food supplies is said to have increased 20 per cent, thus raising the required tenor of workable tin placers.

The following table shows the output of the four producing States during the last two years:

Production of tin in federated Malay States in 1904 and 1905.[b]

[Pikuls: 1 pikul = 133⅓ pounds.]

	1904.	1905.	Increase (+) or decrease (−).
Perak	450,670	446,782	− 3,888
Selangor	304,701	289,867	−14,834
Negri Sembilan	85,688	85,133	− 555
Pahang	28,068	34,879	+ 6,811
Total	869,127	856,661	−12,466
	[c] 57,942	[c] 57,111	[c] − 831

[a] Richardson, G. B., Tin in the Franklin Mountains, Texas; Bull. U. S. Geol. Survey No. 285, 1906, pp. 146-149.
[b] Min. Jour. Rwy. and Com. Gaz. (London), vol. 79, No. 3682, March 17, 1906, p. 352.
[c] Short tons.

The depletion of many of the tin placers is causing great effort to be made to locate new placer fields, and English, American, and other prospectors and engineers have been employed at this work. The scarcity of the metal has also encouraged the prospecting and mining of tin veins, and considerable development has taken place in lode mining on the east side of the Malay Peninsula.

Banka and Billiton.—The total tin sales from Banka and Billiton for 1905 showed a decided falling off from those of 1904. The shortage is undoubtedly largely due to exhaustion of the placers.

Australia.—In Australia there was a small increase in the production during 1905 as compared with 1904. The Mount Bischoff mine, Tasmania, remains one of the largest tin mines of the world, and mines in Queensland are producing very rich ore. Dredges are working tin-bearing gravels successfully in Queensland, New South Wales, Tasmania, and western Australia and are projected for Victoria.

The total shipments from the great Asiatic-Australian tin belt for 1904 and 1905, as given by the Mining Journal (London),[a] are as follows:

Shipments of tin from Asia and Australia in 1904 and 1905.

[Short tons.]

Year.	Shipments of tin from Straits to Europe and United States.	Shipments to India and China.	Banka tin sales.	Billiton tin sales.	Shipments of Australian tin.	Total.
1904	64,309	3,652	12,727	3,601	5,427	89,716
1905	63,661	1,904	11,155	3,041	5,631	85,392

In the figures of shipments from the Straits are included ores from Singkep, Billiton, Siam, and West Australia sent to Singapore for smelting.

Bolivia.—The production of tin in Bolivia in 1905 seems to have been about the same as in 1904, and the exports are given by Mr. C. Mayer[b] as 13,328 short tons for each year. Mr. J. Ramsay Smith, British vice-consul at Oruro, gives the following figures of production of tin in Bolivia for 1905:[c]

Output of barrilla or tin concentrates in Bolivia in 1905, by districts.

	Long tons.
Oruro	15,180
Chorolque, Potosi } January–June	3,500
Huanuni	[d] 460
Panza	[e] 200
Total	[f] 19,340

This is equivalent to an output of 13,646 short tons of metallic tin. Although there are many rich tin mines in Bolivia, many of them are located at long distances from railroads; both fuel and water are scarce; the country is rough; the altitudes are great—conditions that make it almost impossible to work the deposits. New lines of railroad running into Argentina and to navigable waters of the Amazon will undoubtedly increase the production by making larger portions of the country accessible.

Great Britain.—In Great Britain, Cornwall, which has produced tin for more than two thousand years, had an output during 1905 of 5,040 short tons. Practically the

[a] Min. Jour. Rwy. and Com. Gaz. No. 3675, vol. 79, January 27, 1906, pp. 123–124.
[b] Supplement official daily market report, New York Metal Exchange January 9, 1906.
[c] Min. Jour., Rwy. and Com. Gaz., London, vol. 79, June 2, 1906, p. 72.
[d] 64 per cent tin.
[e] 78 per cent tin.
[f] General average, 63 per cent tin

whole output is used in the country, any part reaching the United States being in a manufactured form. The proposed opening of abandoned tin mines, owing to the present high prices of tin, is an interesting late development in Cornwall.

China.—Outside the countries mentioned, with the possible exception of China, the output of tin is insignificant. In the latter country varying quantities, estimated at from 3,000 tons upward per year, are produced in the province of Yunnan. This is generally used in China, though high prices occasionally draw small lots into international trade. About 21 short tons of tin, which may have come from Yunnan, were shipped from Wu Chau during the year.

Other countries.—Small quantities are produced in Burma, Siam, Germany, Austria, Russia, Spain, Portugal, Mexico, Nigeria, Swaziland, and the Transvaal, but the whole amount is probably less than 500 tons.

WORLD'S PRODUCTION OF TIN.

An item that does not appear in the statistics is the quantity of tin used in the producing sections of the Eastern Hemisphere and not shown in the international trade figures, which probably amounts to some hundreds of tons, and would increase by that much the total output shown in the following table:

Approximate tin output of the world during 1905.

	Quantity.	Percentage.
	Short tons.	
Australia	5,028	4.88
Banka	11,155	10.81
Billiton	2,715	2.63
Bolivia	13,646	13.23
Cornwall	5,040	4.88
Malay States	65,565	63.57
Total	103,149	100.00

This total is about the same as that of 1904, which was 103,134 short tons, the difference between the two not being as large as the errors in the figures.

IMPORTS.

The following table shows the imports for consumption of tin into the United States for the calendar years from 1898 to 1905, inclusive:

Tin imported and entered for consumption in the United States, 1898–1905.

[Short tons.]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1898	31,374	$8,770,221	1902	42,522	$21,263,337
1899	35,624	16,748,107	1903	41,567	22,265,336
1900	34,995	19,458,586	1904	41,472	22,356,895
1901	37,280	19,024,761	1905	44,188	26,316,023

THE TIN MARKET.

During 1905 the United States imported 44,188 short tons, about 43 per cent of the total visible output, valued at $26,316,023, giving an average price of 29.77 cents per pound. This is, however, considerably below the price at which tin sold in New York City during the year. The price of tin at the opening of the year was 29.05 cents, and it gradually rose, with slight fluctuations, until about the middle of December, when it went above 36 cents, closing at about $37\frac{3}{8}$ cents. Since January 1, 1906, the price has risen greatly, reaching at one time £215 per long ton on the London market and $48\frac{1}{2}$ cents per pound on the New York market. The price soon fell until in June, 1906, it was between 38 and 40 cents per pound.

There has been good reason for tin to rise in price, for, although the production of 1905 was about the same as that of 1904, the consumption increased considerably, and stocks have materially diminished. Nevertheless, the highest prices are probably due largely to speculation, from which cause the price of tin has suffered violent fluctuations through many years. These fluctuations have been so remarkable that the following table showing the highest and lowest prices during the last fifty-six years is quoted:[a]

Fluctuations of Straits tin in London since 1850.

[Per long ton, in pounds sterling.]

Year.	Opening.	Highest.	Lowest.	Closing.	Year.	Opening.	Highest.	Lowest.	Closing.
1850	78	85	70	83	1879	61	96	59	92
1851	83	88	78	82	1880	92	101	68	91
1852	82	98	77	98	1881	92	110	86	109
1853	98	125	97	125	1882	108	114	92	92
1854	125	126	105	111	1883	93	99	83	86
1855	111	130	104	130	1884	85	87	73	75
1856	130	143	126	143	1885	75	97	74	93
1857	143	150	95	100	1886	93	103	92	100
1858	100	125	100	125	1887	100	167	100	167
1859	125	142	125	135	1888	168	170	75	100
1860	135	135	129	130	1889	99	100	88	97
1861	130	130	110	117	1890	98	104	88	91
1862	117	119	110	117	1891	91	94	89	90
1863	117	128	113	114	1892	91	103	88	91
1864	114	120	87	91	1893	91	95	74	74
1865	91	97	87	95	1894	$73\frac{1}{2}$	74	$60\frac{7}{8}$	$60\frac{7}{8}$
1866	95	95	75	85	1895	$60\frac{1}{2}$	$68\frac{7}{8}$	$58\frac{5}{8}$	59
1867	85	91	83	87	1896	$58\frac{3}{4}$	$67\frac{3}{4}$	56	$58\frac{3}{8}$
1868	87	109	87	108	1897	$58\frac{1}{2}$	$63\frac{5}{8}$	$58\frac{1}{2}$	$62\frac{7}{8}$
1869	109	140	108	109	1898	63	$86\frac{1}{16}$	$62\frac{5}{8}$	$86\frac{1}{16}$
1870	109	135	103	132	1899	$87\frac{1}{4}$	$150\frac{7}{16}$	$86\frac{1}{2}$	$111\frac{3}{4}$
1871	132	157	123	144	1900	115	153	$108\frac{1}{4}$	$122\frac{3}{8}$
1872	144	160	130	138	1901	121 10	140	100	$106\frac{1}{2}$
1873	140	148	114	117	1902	105 15	$137\frac{1}{2}$	$100\frac{1}{2}$	120 7 6
1874	117	121	87	95	1903	120 12 6	$141\frac{1}{2}$	111 15	132 17 6
1875	95	96	76	80	1904	133 10 0	136 10 0	116 15 0	134 0 0
1876	80	81	70	75	1905	132 2 6	165 12 6	129 15 0	160 12 6
1877	75	76	64	66	1906	$161\frac{1}{5}$	215[a]	....	....
1878	66	66	$52\frac{1}{2}$	61					

[a] May.

The first imports of Australian tin were in 1872; of Billiton in 1865, and of Singkep in 1892.

The high price of tin during recent years has greatly stimulated prospecting for new deposits of tin ore, but so far the only notable discoveries reported are one in the Transvaal and one in Nigeria, neither of which has yet been proved to be capable of yielding large quantities of the metal.

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[a] Supplement Official daily market report of the New York Metal Exchange, Jan. 9, 1906.

SUBSTITUTES FOR TIN.

The rise in price has also caused a search for a substitute for tin in the manufactures. The possible use of such substitutes is well summed up by L. Parry [a] in an excellent article, from which the following quotations are made:

The diminution in the price of aluminum, the practically limitless supply of raw material, and the physical properties of the metal are facts which must at once appeal to the technical imagination, and point to this—the most abundant of the metallic elements—as a possible substitute for tin. At the same time it is not the only metal which has to be considered in this connection.

The world's annual production of tin is now about 91,000 tons (long), and the principal uses to which the metal is applied are as follows:

A. The manufacture of tin plates. Tin plate holds from 2 to 3 per cent of tin. Two samples recently assayed by the writer contained 2.65 per cent (thin piece) and 3 per cent (thick piece), respectively. The tin-plate production of South Wales is probably about 12,000,000 to 13,000,000 boxes and that of the United States of America about the same. Germany is probably the next largest producer, with about 1,000,000 boxes, or, say, 1,350,000 tons, for the world's production. The tin in tin plate is stated on good authority to run about $2\frac{1}{4}$ pounds per hundredweight on output, or about 2 per cent, which means that about 27,000 tons of metal are consumed for this purpose.

B. The manufacture of machine bronzes and brasses, which in all probability accounts for the greater proportion of the world's consumption.

C. The manufacture of various white alloys, such as solder, type metal, pewter, britannia metal, white bearing metals, to mention the more important. Of these we would particularly direct attention to the ever-increasing consumption of white bearing metals, or so-called antifriction metals, which contain all percentages of tin up to 90 per cent, and which, we might incidentally add, all hold 5 to 20 per cent antimony as an essential constituent—a point which may have some bearing on the increased price of antimony. Of other white alloys we have capsule metal, tea lead, tinfoil, electric fuse metal, accumulated metal, metallic packing, fusible alloys, and the various white alloys holding tin which are used for making ornaments and toys.

D. Ornamental bronzes and gold and silver plated white metals.

E. Tin crystals, tin oxide, etc. A considerable amount of stannous chloride (tin crystals) is consumed in various branches of textile industry. Tin oxide is the principal constituent of many polishing powders.

Mr. Parry then treats these uses thus:

A. With regard to tin plate, there is very little doubt that many of the uses to which it is applied could be quite well fulfilled by aluminum or galvanized iron, or, assuming the manufacture of such a material to be a practicable proposition, by aluminum plate—that is, iron coated with aluminum. The price of aluminum is now about that of tin and about fourteen times that of tin plate, and as the specific gravity of aluminum is, roughly, one-third that of tin plate, the cost of aluminum sheet would be about four and a half times ($\frac{1}{3}\times14$) that of tin plate of the same thickness. A rise in the price of tin does not, of course, affect very greatly the price of tin plate; thus on January 6 tin plates 20 by 14 were quoted at 13s. 3d. per box and on May 19 at 14s., an increase of 9d. per hundredweight, or 15s.—£0.75 per ton. We should note that the price of steel bars had meanwhile dropped from £5 5s. to £5. The price of tin on January 6 was £163 and on May 19 £194, an increase of about £30 a ton. If we assume, for the sake of argument, that there is 3 per cent of tin in tin plate, the increased cost of producing plates would be 3 per cent by £30–£.9 per ton, which agrees pretty closely with the actual increase. An increase of £33 in the price of tin means an increase in the cost of producing plates £1 per ton, or 1s. only per hundredweight. It is obvious from these figures that a very large increase in the price of tin can have practically no influence in diminishing the relative cost of aluminum sheet as against that of tin plate; with aluminum and tin at the same price, there is a margin of £50 or £60 between the cost of equal bulks of the two materials. Thus before aluminum sheet can hope to compete with tin plate in the matter of price, one or both of two things must happen—namely (a), an undreamt of increase in the price of tin, (b) a considerable lowering in the price of aluminum—a point to which we shall again refer. With regard to aluminum plate, the matter is very different; the cost of tin and aluminum being about the same, there might easily be very little difference in the cost of producing the two kinds of plate, and that difference might, as far as we know, be on either one side or the other, though it would seem probable that the cost of producing aluminum plate would necessarily be greater, owing to the higher melting point of aluminum and its ready oxidizability. However, a rise of £20 or £30 a ton in the price of tin might then be sufficient to turn the scale in favor of aluminum plate, other things being the same. As is well known, aluminum is sufficiently tenacious and malleable to replace tin plate, resists atmospheric influences well, and, whether as plate or sheet, could be employed in the manufacture of many domestic utensils and vessels used for containing food stuffs, tobacco, etc. There

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[a] Substitutes for tin: Min. Jour. Rwy and Com. Gaz., London, vol. 79, June 2, 1906, p. 728.

can not be much objection (apart, of course, from cost) to its use in the case of such things as tea, coffee, cocoa, biscuits, tobacco; but in the case of preserved fruits, meat, and vegetables the objection has been made that aluminum is attacked by organic acids. This is a very important point, and one upon which there is much conflict of opinion. It would seem that the liability of aluminum to attack by fruit acids depends largely on its purity. In any case, we must remember that the aluminum industry is in its infancy, that the power of resistance of the metal to organic acids is a matter which requires investigating, and that we can scarcely condemn its use in such connection on the strength of the scanty knowledge we possess.

B. Machine bronzes and brasses may contain up to 5 per cent tin, according to the purposes for which they are required. As the world's annual output of copper is now about 800,000 tons, and that a very large proportion of this is employed in the manufacture of machine bronzes and brasses, we see at once that this must mean a correspondingly large consumption of tin. Many of the essential physical properties of tin-copper or tin-copper-zinc alloys may be obtained by the partial or complete substitution of tin by aluminum, manganese, nickel, or iron, though it would, perhaps, be incorrect to say that such an effect could always be produced or that such alloys would be invariably cheaper. The object of successful brass founding is the production of a suitable alloy at a profit. If, for instance, the price of tin, aluminum, and nickel happened to be about the same, and it was found possible to obtain the properties required in a gun metal holding 90 of copper and 10 of tin by adding 1 or 2 per cent each of aluminum, nickel, and tin to a copper-zinc base, it would certainly pay to do so. A rise in the price of tin should stimulate research in the direction of such combinations. It is an unfortunate fact, however, that the English brass founder is disinclined to spend money on trained technical research, as he has not yet discovered that it would pay him to do so. A large brass founder (English, of course) once expressed to the writer his opinion that a chemical laboratory was a waste of money in a foundry.

The aluminum bronzes and brasses are a most important class of alloys, and will be produced in much larger quantities as the price of tin increases or that of aluminum declines.

C. Of the important white metals we may say at once that solder and type are required on account of such special and definite combinations of physical properties that their replacement by other metals to any appreciable extent is quite improbable. With regard to white bearing metals, again the tin which is used in their manufacture confers physical properties upon them which can scarcely be otherwise obtained, so that the consumption of tin in their manufacture is likely to increase rather than to diminish.

D. With regard to ornamental bronzes it is difficult to speak with any degree of certainty. The use of tin, however, is not an absolute necessity, and its consumption for the purpose has been diminishing for some time. On the other hand, an increased amount of tin is probably now used in the manufacture of white-metal ornaments—e. g., in the case of white bronzes.

Many white-metal combinations are employed in making ornaments, and it is probable that the demand with regard to quality readily accommodates itself to the supply. The quality of such goods probably varies far more than the price. If tin keeps up in price for a year or two it will probably be found that the percentage of tin in white-metal ornaments will diminish considerably. With regard to white metals used as bases for electroplating with gold and silver, it has already been found possible to use aluminum. The processes are still in their infancy, but no doubt the use of aluminum for this purpose will become more and more common.

COAL.

By Edward W. Parker.

INTRODUCTION.

The coal-mining industry of the United States in 1905 was marked by an unprecedented tonnage, both in actual amount and in the increase over the preceding year, accompanied by a general depression in prices, which indicated that the supply thrown upon the market was in excess of its needs. Outside of this there was nothing of special interest to record. Little interference to regular operations was experienced in the way of labor troubles, and what little time was lost by strikes or lockouts was not sufficient to exert any influence on the production. During the latter part of the year, and for the first three months of 1906, production was unduly stimulated in the effort to secure large supplies of coal in case of a suspension of mining as a result of the termination, on March 31, 1906, of the wage-scale agreements in the bituminous fields, and of the awards of the Strike Commission in the anthracite field of Pennsylvania. Fortunately for all interested, and for the public in particular, while there was a general suspension of mining, which lasted in some cases for several weeks, the differences between the miners and the operators were with a few exceptions adjusted, and the public was not put to serious inconvenience nor was arbitration necessary, though at times appearances of a peaceful settlement were decidedly remote.

The statistics presented in the following pages, which consider primarily the details of amount and value of coal produced in 1905, with comparisons with previous years, include also statements regarding the labor employed, the average number of days worked, the length of the working days, the production per man, the use of mining machines, and the tonnage produced by them, the casualties reported by mine inspectors, and other matters of interest connected with the mining and marketing of coal. Summaries of the results of tests made at the Geological Survey coal-testing plant at St. Louis, Mo., to the close of 1905, are given in connection with the discussion of the production in the different States.

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. The summaries of tests made at the

testing plant in St. Louis have been prepared by Mr. Samuel Sanford, of the Geological Survey. The writer also desires to acknowledge the efficient work of Miss Lida Mann in the tabulation of the schedules and the preparation of the tables of production, etc.

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.

TESTS OF COALS AND LIGNITES.

The results of the more important tests and analyses of coals collected from different parts of the United States and which were made in 1904 and 1905 at the coal-testing plant of the Geological Survey in St. Louis are briefly summarized under the discussion of the production in each State. The equipment of the plant included 2 Heine safety water-tube boilers for steaming tests, a Taylor pressure gas producer, 3 standard beehive ovens for coking, 2 patterns of jigs for washing, an American and an English machine for making briquets, and a chemical laboratory expressly fitted up for analyzing and determining the calorific value of coal. All the tests were made with raw coal except in cases where the contrary is stated; all the official briquetting tests mentioned were made with the English machine. For more detailed reports on these tests the reader is referred to Professional Paper No. 48 and to Bulletin No. 290. The former, which has been published in three volumes, contains a full and complete report on the work done during the Exposition period, while the latter gives in a brief and preliminary form the results accomplished during the calendar year 1905. It should be stated in connection with all of these tests that every precaution was taken to secure as samples for analysis and test coal which fairly represented the average output of the mine. The minimum amount received for testing purposes was one carload, which was shipped under the supervision of inspectors employed by the Geological Survey. In all but a few instances two inspectors were detailed to supervise each shipment. They also sampled the coal in the mine under the rules for coal-mine sampling prescribed by the American Chemical Society and adopted by the Geological Survey. Copious notes regarding the character of the coal bed, the methods of mining, ventilation, haulage, etc., were taken, and these will be used as a basis for further work in the preparation of a report on coal-mining methods. The following description of the method of mine sampling is taken from the chapter by Mr. J. S. Burrows, chief inspector, on the field work in 1905, as published in Bulletin No. 290.

Mine sampling, as it is done at present by the inspectors of the fuel-testing plant, consists of first making a careful study of the coal throughout the mine and observing what parts of the bed are discarded by the miner. Two or more places where the coal is of average development are then selected. These places are usually at widely separated points in the part of the mine from which most of the coal is being shipped. The face is then cleared of burned powder, loose coal, and dirt for 5 feet or so, and insecure pieces of the roof are taken down to prevent their falling into the sample. The sampler then spreads a rubber blanket on the floor of the mine close up to the face of the coal and makes a perpendicular cut from floor to roof, including everything in the sample but the parts of the bed discarded by the miner. He cuts sufficient coal to make not less than 5 pounds per foot in height—that is, a sample weighing not less than 30 pounds would be cut from a 6-foot seam of coal. When shale or other partings are to be included in the sample, great care is exercised in cutting them the full width and depth of the groove in order to preserve the proper proportions of coal and extraneous matter. When the required amount of coal is obtained a detailed record is made of the section of the bed from top to bottom, every perceptible parting and variation in the section being noted. The parts of the bed not included in the sample are clearly shown in this record, and from these notes the value of the sample may be judged.

The cuttings are at once weighed and then sifted through a screen with a half-inch mesh. The remaining lumps are broken up in a portable grinding machine, and this process of screening and breaking is continued until the entire sample will pass through the screen.

The sample is then mixed by two men who stand opposite each other. Grasping the corners of the rectangular blanket, they roll the sample diagonally by raising one corner of the blanket at a time. This mixes the sample very thoroughly, and when the larger pieces are observed to be evenly distributed throughout the mass the sample is divided into four equal quarters. Two opposite quarters are discarded and the remainder mixed as before. If the sample is still too bulky to be conveniently handled, it is again mixed and quartered.

The remaining material is spread into a circular mass about 2 inches deep on the blanket, and a small trowel is used to fill a sample can with alternate sections of the sample taken from the circumference to the center of the mass around the entire circle. The can is closed and hermetically sealed with electrical insulating tape, and the weight is noted. This weight shows accurately what proportion of the original sample is sent to the laboratory.

The entire process of sampling is carried on as rapidly as possible at the place in the mine where the sample is cut. The maximum time for cutting and preparing a large sample is about one hour. Although it is known that rapid changes take place in the moisture content of some coals, it is reasonable to assume that where the sampling is quickly done in the atmosphere to which the native coal is exposed there is probably only a slight gain or loss of moisture while the sample is being broken up and quartered.

In an effort to establish some definite relation between these moisture changes and the atmospheric conditions, temperature, humidity, and dew-point determinations are made at the beginning and completion of the preparation of the sample. Similar readings are taken in the chemical laboratory. When sufficient data have been collected, it is possible that this subject will be more thoroughly understood.

PRODUCTION.

Total production in 1905, 392,919,341 short tons; spot value, $476,756,963.

Pennsylvania anthracite.—Total production in 1905, 69,339,152 long tons (equivalent to 77,659,850 short tons); spot value, $141,879,000.

Bituminous and lignite.—Total production in 1905, 315,259,491 short tons; spot value, $334,877,963.

In the production of coal, as in nearly all of the more important branches of the mining industry, the United States, in 1905, surpassed all previous records. Compared with 1904 the output last year exhibits a gain of 41,102,943 short tons, or 11.7 per cent in quantity, and of $32,385,942, or 7.3 per cent in value. Prior to 1905 the maximum output of coal was obtained in 1903, when the production amounted to 357,356,416 short tons, valued at $503,724,381, compared with which the record for 1905 shows an increase in production of 35,562,925 short tons, and a decrease in value of $26,967,418. The high value recorded in the statistics for 1903 was due to a somewhat abnormal inflation of prices caused by the shortage of fuel supplies which resulted from the prolonged strike in the anthracite region of Pennsylvania the preceding year. The lower values in 1904, as compared with 1903, were simply a return to normal conditions, but the continued decline in 1905 was the result of a production in excess of the market requirements, unusually large as these were.

It is a fact worthy of note that the total increase in the production of coal in the United States in 1905 over 1904 was larger than the total production of France in 1904 (the latest year for which statistics are available) or of any other foreign country except Great Britain, Germany, and Austria-Hungary, and was almost equal to that of the last mentioned. The total production of this country last year was nearly 50 per cent larger than that of Great Britain, which until 1899 was the leading coal-producing country of the world, and more than double that of Germany.

Of the total increase in 1905, 4,020,662 long tons (or 4,503,141 short tons) was in the production of anthracite in Pennsylvania, and 36,599,802 short tons was in the output of bituminous coal and lignite. A portion of the increase in both anthracite and bituminous coal was in all probability due to the efforts put forth by the operating companies to provide a supply of fuel in anticipation of a suspension of mining on April 1, 1906, when the wage-scale agreements in the organized bituminous coal-producing States and the award of the Strike Commission in the anthracite region of Pennsylvania would terminate.

The decline in value was general throughout nearly all the coal-producing States. The average price for anthracite coal at the mines in Pennsylvania declined from $2.35 per long ton in 1904 to $2.25 per ton in 1905. The average price for all the bituminous coal and lignite mined and sold in 1905 was $1.06 per short ton, against $1.10 in 1904. 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 value of the bituminous coal is based upon all the coal sold or used at the mines either for coke making or in the operation of the properties. Only the bituminous coal actually wasted is excluded from the valuation, and this is also not included in the statement of production.

In considering the value of the coal as given in these reports, it is to be remembered that the valuation is based on 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. All of the buckwheat, rice, and other sizes below pea coal shipped from the anthracite region, which are used entirely for steam purposes, are sold at prices considerably below the actual cost of production. In the bituminous regions a large proportion of the coal is marketed as screened coal, and in many cases the sizes below nut are also sold at less than cost.

An interesting fact presented in the statistics of the production of coal in the United States is that in each decade the output has been practically doubled. Up to the close of 1865 the total production had amounted to 284,890,055 tons. In the decade from 1866 to 1875, inclusive, the production amounted to 419,425,104 tons, making the total production up to the close of 1875 704,315,159 tons. In the following decade, from 1876 to 1885, inclusive, the production amounted to 847,760,319 tons, something more than double the total production up to the beginning of that decade. At the close of 1885 the total production amounted to 1,552,075,478 tons, and the production for the 10 years ending with 1895 was 1,586,098,641, and the total production to the close of 1895 amounted to 3,138,174,119 short tons. In the decade ending December 31, 1905, the total production has amounted to 2,832,599,452 short tons, and the grand total from the beginning of coal mining has amounted to 5,970,773,571 short tons.

This great increase in the production of coal when considered with the increase in the population furnishes some further interesting comparisons. Going back for a period of a little over 50 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 10 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 increased 4,084 per cent. Estimating the population of the United States in 1905 at 83,000,000 persons, the per capita production for that year is found to have been 4.73 tons.

The statistics regarding the use of undercutting machines in the bituminous coal mines of the United States, the details of which are found in subsequent pages of this report, show that in 1905 the total amount of coal mined by the use of machines was 103,396,452 short tons, or 33.69 per cent of the total production in the States where mining machines were used, as compared with 78,606,997 short tons, or 28.8 per cent of the equivalent total in 1904, and 77,974,894 short tons, or 28.18 per cent of the total in 1903. The total number of mining machines in use has increased from 6,658 in 1903 to 7,663 in 1904 and to 9,184 in 1905. The average production for each machine in use last year was 11,258 short tons, against 10,258 in 1904 and 11,712 in 1903. Of the 9,184 machines in use in 1905, 5,525, or 60 per cent, were of the pick or puncher type; 3,557, or 38.8 per cent, were chain-breast machines, and 102, or 1.2 per cent, were of the long-wall pattern. The largest number of both pick and chain-breast machines in use in any State was in the bituminous mines of Pennsylvania, while 63 per cent of the long-wall machines were employed in mines of Ohio and Missouri.

The total number of men and boys employed in the coal mines of the United States in 1905 was 626,174, against 593,693 in 1904 and 566,260 in 1903. Of the total number employed in 1905, 165,406 were employed in the anthracite regions of Pennsylvania, against 155,861 in 1904 and 150,483 in 1903. The bituminous mines gave employment to 460,768 in 1905, 437,832 in 1904, and 415,777 in 1903. The average number of days worked in the anthracite region in 1905 was 215, and in the bituminous region 211 days. In 1904 the employees in the anthracite region averaged 200 days and those in the bituminous mines 202 days. In 1905 the average production for each employee in the anthracite region was 469 short tons, the same average as made in 1904, while in 1903 the average production for each employee was 496 tons. The average bituminous production for each employee for 1905 was 684 short tons, against 636 tons in 1904 and 680 tons in 1903. The average tonnage per day per man in the anthracite region has decreased from 2.41 in 1903 to 2.35 in 1904 and 2.18 in 1905, while the average bituminous tonnage per day per man has increased from 3.02 in 1903 to 3.15 in 1904 and 3.24 in 1905. This increased tonnage per man per day in the bituminous region may be attributed to the larger proportion of bituminous coal mined by the use of machines.

The coal-mining industry in 1905 was comparatively free from labor disturbances, the only exception to a general rule of peace being in Illinois, where a large number of mines were shut down as a result of the disagreement between the miners and the operators on the question of what is known as the "shot-firers'" law. The effect of this legislation and the settlement of the strike arising from it are discussed in detail under the heading of "Labor troubles," on page 44.

Practically the entire output of both anthracite and bituminous coal of the United States is consumed within this country. The total exports in 1905 amounted to 10,281,878 short tons, which, deducted from the production of 392,919,341 short tons, shows the consumption of coal of domestic production to have amounted to

382,637,453 short tons. If to this amount is added the imports, which in 1905 amounted to 1,842,672 short tons, the total consumption of coal in the United States last year (considering as negligible the stocks on hand at the beginning and the end of the year) is shown to have been 384,480,135 short tons, which is equivalent to 98 per cent of the total 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 at 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 of coal consumed in the manufacture of coke at the mines in 1905 amounted to 42,412,328 short tons, as compared with 31,278,537 short tons in 1904, an increase of 11,133,791 short tons. The coal shipped to the market, used in the manufacture of coke, and sold locally, which is considered as a marketable product, amounted in 1905 to 378,876,322 short tons, as compared with 343,939,935 short tons in 1904 and 344,722,763 short tons in 1903. 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. The colliery consumption of anthracite coal in 1905 was 7,035,925 short tons, or about 9 per cent of the total, while the colliery consumption of the bituminous mines was only a little less than that of the anthracite, or 7,007,094 short tons, a little more than 2 per cent of the bituminous production.

There were 31 States and Territories in the United States in which coal was produced in 1904 and 1905. Of these there were 22 in which the production in 1905 exceeded that of 1904, while in 1904 there were only 9 in which the production exceeded that of 1903. In 3 States—Kansas, Ohio, and Texas—the value decreased notwithstanding the increase in production, while in the production of Washington there was a decrease in output and an increase in value. It is to be noted that the largest increases comparatively among the more important producing States were made in those in which the manufacture of coke is an important branch of the coal-mining industry; as, for instance, in the bituminous production of Pennsylvania the increase was 20,475,350 short tons, or 20.9 per cent. In West Virginia the increase amounted to 5,384,828 short tons, or 16.6 per cent. Alabama's production increased 604,023 short tons, or 5.4 per cent; Colorado's, 2,168,074 short tons, or 33 per cent, and Virginia's increased 864,357 short tons, or 25.3 per cent. A notable exception to this rule is presented in the production of Indiana, which increased 1,053,063 short tons, or 9.7 per cent, this increase being due to the recent developments in Greene and Sullivan counties in that State. The production of anthracite coal in Pennsylvania shows an increase of 4,503,141 short tons, or 6.2 per cent.

Statistics of the production of coal in the United States in 1904 and 1905, by States, with the distribution of the product for consumption, the total value, and the statistics of the labor employed, are shown in the following tables:

Coal production of the United States in 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	9,881,510	653,187	307,492		10,842,189	12,004,300	1.11	177	19,587
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	6,879,247	423,160	180,970	93,105	7,576,482	7,868,192	1.04	197	14,235
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	6,801,751	1.63	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	183,656	83,185	5,087		271,928	389,052	1.43	192	554
Ohio	22,563,735	1,420,012	415,517	956	24,400,220	26,579,738	1.09	175	43,634
Oregon	79,293	13,968	18,279		111,540	243,588	2.18	149	334
Pennsylvania	73,569,449	1,521,106	1,979,364	20,868,368	97,938,287	94,428,219	.96	196	135,100
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	1,729,840	40,985	63,085	1,577,004	3,410,914	2,921,911	.86	238	5,165
Washington	2,911,612	28,603	120,228	77,235	3,137,681	5,120,931	1.63	243	5,287
West Virginia	27,886,512	607,290	419,182	3,493,768	32,406,752	28,647,014	.88	197	47,235
Wyoming	4,903,257	52,391	216,308	6,600	5,178,556	6,747,909	1.30	262	5,660
Total bituminous	231,487,915	9,596,761	6,296,476	31,278,537	278,659,689	305,397,001	1.10	202	437,832
Pennsylvania anthracite	64,654,410	6,922,282	1,579,987		73,156,709	138,974,020	1.90	200	155,861
Grand total	296,142,355	16,519,043	7,876,463	31,278,537	351,816,398	444,371,021	1.26	202	593,693

[a] Includes production of Nevada.

Coal production of the United States in 1905, 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	8,003,053	380,210	350,872	3,131,934	11,866,069	$14,387,721	$1.21	225	19,595
Arkansas	1,869,173	13,296	52,204	....	1,934,673	2,880,738	1.49	177	4,192
California and Alaska	74,534	3,572	2,718	....	80,824	395,975	4.97	294	144
Colorado	6,315,435	183,748	216,702	2,110,514	8,826,429	10,810,978	1.22	255	11,020
Georgia and North Carolina	225,156	2,244	7,113	119,035	353,548	456,184	1.29	266	816
Idaho[a]	....	5,662	220	....	5,882	17,846	3.03	107	37
Illinois	34,160,115	2,891,220	1,374,308	8,720	38,434,363	40,577,592	1.06	201	58,053
Indiana	10,835,345	732,856	327,051	....	11,895,252	12,492,255	1.05	151	25,323
Indian Territory	2,707,377	38,898	106,547	71,605	2,924,427	5,145,358	1.76	188	7,712
Iowa	5,874,056	759,203	165,350	....	6,798,609	10,586,381	1.56	209	15,113
Kansas	6,097,407	209,985	116,587	....	6,423,979	9,350,542	1.46	212	11,926
Kentucky	7,617,366	476,174	195,140	143,843	8,432,523	8,385,232	.99	200	14,685
Maryland	5,010,997	49,779	47,763	....	5,108,539	5,831,760	1.14	252	5,948
Michigan	1,350,584	66,728	55,899	....	1,473,211	2,512,697	1.71	186	3,696
Missouri	3,559,814	337,667	85,897	....	3,983,378	6,291,661	1.58	194	8,962
Montana	1,465,806	45,121	64,128	68,777	1,643,832	2,823,350	1.72	243	2,181
New Mexico	1,422,129	20,830	45,263	161,711	1,649,933	2,190,231	1.33	234	2,108
North Dakota	207,514	99,672	10,356	....	317,542	424,778	1.34	187	626
Ohio	24,012,691	1,123,381	415,712	1,166	25,552,950	26,486,740	1.04	176	43,399
Oregon	84,258	7,883	17,500	....	109,641	282,495	2.58	242	316
Pennsylvania	86,018,041	2,236,728	2,232,586	27,926,282	118,413,637	113,390,507	.96	231	143,629
Tennessee	5,002,762	88,525	94,271	777,838	5,963,396	6,797,550	1.14	222	12,198
Texas	1,162,797	10,881	27,006	....	1,200,684	1,968,558	1.64	238	3,008
Utah	1,011,914	22,522	50,351	247,585	1,332,372	1,793,510	1.35	247	1,361
Virginia	2,010,088	59,086	87,433	2,118,664	4,275,271	3,777,325	.88	241	5,730
Washington	2,634,349	38,011	103,950	88,616	2,864,926	5,141,258	1.79	227	4,765
West Virginia	31,159,464	682,448	524,517	5,425,151	37,791,580	32,341,790	.86	209	48,389
Wyoming	5,309,136	52,378	229,650	10,857	5,602,021	7,336,951	1.31	236	5,977
Total bituminous	255,201,361	10,638,708	7,007,094	42,412,328	315,259,491	334,877,963	1.06	211	460,909
Pennsylvania anthracite	69,052,964	1,570,961	7,035,925	....	77,659,850	141,879,000	1.83	215	165,406
Grand total	324,254,325	12,209,669	14,043,019	42,412,328	392,919,341	476,756,963	1.21	212	626,315

[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 1905 as compared with 1904. It will be observed that the principal increases among the bituminous coal-producing States, with the exception of Indiana and Kentucky, were in those States in which the coke-making industry is highly developed, namely, Pennsylvania, West Virginia, Colorado, Alabama, Virginia, and Tennessee.

Quantity and value of coal produced in the United States, 1901–1905.

State or Territory.	1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
Alabama	9,099,052	$10,000,892	10,354,570	$12,419,666	11,654,324	$14,246,798
Arkansas	1,816,136	2,068,613	1,943,932	2,539,214	2,229,172	3,360,831
California and Alaska	152,379	409,706	87,196	273,398	105,420	301,318
Colorado	5,700,015	6,441,891	7,401,343	8,397,812	7,423,602	9,150,943
Georgia and North Carolina	354,825	426,685	437,083	623,518	434,260	546,759
Idaho	....	....	2,030	5,189	4,250	13,250
Illinois	27,331,552	28,163,937	32,939,373	33,945,910	36,957,104	43,196,809
Indiana	6,918,225	7,017,143	9,446,424	10,399,660	10,794,692	13,244,817
Indian Territory	2,421,781	3,915,268	2,820,666	4,265,106	3,517,388	6,386,463
Iowa	5,617,499	7,822,805	5,904,766	8,660,287	6,419,811	10,563,910
Kansas	4,900,528	5,991,599	5,266,065	6,862,787	5,839,976	8,871,953
Kentucky	5,469,986	5,213,076	6,766,984	6,666,967	7,538,032	7,979,342
Maryland	5,113,127	5,046,491	5,271,609	5,579,869	4,846,165	7,189,784
Michigan	1,241,241	1,753,064	964,718	1,653,192	1,367,619	2,707,527
Missouri	3,802,088	4,707,164	3,890,154	5,374,642	4,238,586	6,834,297
Montana	1,396,081	2,009,316	1,560,823	2,443,447	1,488,810	2,440,846
New Mexico	1,086,546	1,546,652	1,048,763	1,500,230	1,541,781	2,105,785
North Dakota	166,601	214,151	226,511	325,967	278,645	418,005
Ohio	20,943,807	20,928,158	23,519,894	26,953,789	24,838,103	31,932,327
Oregon	69,011	173,646	65,648	160,075	91,144	221,931
Pennsylvania:						
Anthracite	67,471,667	112,504,020	41,373,595	76,173,586	74,607,068	152,036,448
Bituminous	82,305,946	81,397,586	98,574,367	106,032,460	103,117,178	121,752,759
Tennessee	3,633,290	4,067,389	4,382,968	5,399,721	4,798,004	5,979,830
Texas	1,107,953	1,907,024	901,912	1,477,245	926,759	1,505,383
Utah	1,322,614	1,666,082	1,574,521	1,797,454	1,681,409	2,026,038
Virginia	2,725,873	2,353,989	3,182,993	2,543,595	3,451,307	3,302,149
Washington	2,578,217	4,271,076	2,681,214	4,572,295	3,193,273	5,380,679
West Virginia	24,068,402	20,848,184	24,570,826	24,748,658	29,337,241	34,297,019
Wyoming	4,485,374	6,060,462	4,429,491	5,236,339	4,635,293	5,731,281
Total	293,299,816	348,926,069	301,590,439	367,032,069	357,356,416	503,724,381

Quantity and value of coal produced in the United States, 1901–1905—Continued.

State or Territory.	1904.		1905.		Increase or decrease, 1905.		Per cent of increase or decrease, 1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*			
Alabama	11,262,046	$13,480,111	11,866,069	$14,387,721	+ 604,023	+ $907,610	+ 5.4	+ 6.7
Arkansas	2,009,451	3,102,660	1,934,673	2,880,738	− 74,778	− 221,922	− 3.7	− 7.2
California and Alaska	79,582	377,306	80,824	395,975	+ 1,242	+ 18,669	+ 0.2	+ 4.9
Colorado	6,658,355	8,751,821	8,826,429	10,810,978	+ 2,168,074	+ 2,059,157	+32.6	+23.5
Georgia and North Carolina	390,191	476,996	353,548	456,184	− 36,643	− 20,812	− 9.4	− 4.4
Idaho [a]	3,480	13,730	5,882	17,846	+ 2,402	+ 4,116	+69.0	+30.0
Illinois	36,475,060	39,941,993	38,434,363	40,577,592	+ 1,959,303	+ 635,599	+ 5.4	+ 1.6
Indiana	[b] 10,842,189	[b] 12,004,300	11,895,252	12,492,255	+ 1,053,063	+ 487,955	+ 9.7	+ 4.1
Indian Territory	3,046,539	5,532,066	2,924,427	5,145,358	− 122,112	− 386,708	− 4.0	− 7.0
Iowa	6,519,933	10,504,406	6,798,609	10,586,381	+ 278,676	+ 81,975	+ 4.3	+ 0.8
Kansas	6,333,307	9,640,771	6,423,979	9,350,542	+ 90,672	− 290,229	+ 1.4	− 3.0
Kentucky	[b] 7,576,482	[b] 7,868,192	8,432,523	8,385,232	+ 856,041	+ 517,040	+11.3	+ 6.6
Maryland	4,813,622	5,729,085	5,108,539	5,831,760	+ 294,917	+ 102,675	+ 6.1	+ 1.8
Michigan	1,342,840	2,424,935	1,473,211	2,512,697	+ 130,371	+ 87,762	+ 9.7	+ 3.6
Missouri	4,168,308	[b] 6,801,751	3,983,378	6,291,661	− 184,930	− 510,090	− 4.4	− 7.5
Montana	1,358,919	2,194,548	1,643,832	2,823,350	+ 284,913	+ 628,802	+21.0	+28.7
New Mexico	1,452,325	1,904,499	1,649,933	2,190,231	+ 197,608	+ 285,732	+13.6	+15.0
North Dakota	[b] 271,928	[b] 389,052	317,542	424,778	+ 45,614	+ 35,726	+16.8	+ 9.2
Ohio	[b] 24,400,220	[b] 26,579,738	25,552,950	26,486,740	+ 1,152,730	− 92,998	+ 4.8	− 0.3
Oregon	111,540	243,588	109,641	282,495	− 1,899	+ 38,907	− 1.7	+16.0
Pennsylvania:								
Anthracite	73,156,709	138,974,020	77,659,850	141,879,000	+ 4,503,141	+ 2,904,980	+ 6.2	+ 2.1
Bituminous	[b] 97,938,287	[b] 94,428,219	118,413,637	113,390,507	+20,475,350	+18,962,288	+20.9	+20.1
Tennessee	4,782,211	5,642,393	5,963,396	6,797,550	+ 1,181,185	+ 1,155,157	+24.7	+20.5
Texas	1,195,944	1,983,636	1,200,684	1,968,558	+ 4,740	− 15,078	+ 0.4	− 0.8
Utah	1,493,027	1,943,440	1,332,372	1,793,510	− 160,655	− 149,930	−10.8	− 7.7
Virginia	[b] 3,410,914	[b] 2,921,911	4,275,271	3,777,325	+ 864,357	+ 855,414	+25.3	+29.3
Washington	3,137,681	5,120,931	2,864,926	5,141,258	− 272,755	+ 20,327	− 8.7	+ 0.4
West Virginia	[b] 32,406,752	[b] 28,647,014	37,791,580	32,341,790	+ 5,384,828	+ 3,694,776	+16.6	+12.9
Wyoming	5,178,556	6,747,909	5,602,021	7,336,951	+ 423,465	+ 589,042	+ 8.2	+ 8.7
Total	[b] 351,816,398	[b] 444,371,021	392,919,341	476,756,963	+41,102,943	+32,385,942	+11.7	+ 7.3

[a] Includes production of Nevada.

[b] Corrected figures. In the report for 1904, the total production for the United States for that year was given at 352,310,427 short tons, valued at $444,816,288. In collecting the statistics for 1905 it was found that in several cases where properties had changed hands or the name of the company had been changed the preceding year, the production for the entire year had been reported by both owners. The duplications thus made have been corrected for this report.

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 25 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 77,659,850 short tons in 1905—a gain of 49,010,038 short tons, or 171 per cent—the bituminous production has grown from 42,831,758 short tons in 1880 to 315,259,491 short tons in 1905, an increase of 272,427,733 short tons, or 636 per cent. Although the anthracite production during the last 3 years 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, although in 1904 and 1905 the prices were lower than in 1903. This has been due to the larger proportion of the small and cheaper sizes used, and not to any decline in the prices of domestic sizes. The increased expense in the mining of anthracite has 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 undesirable 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 39.1 per cent in 1905, while the percentage of the sizes above pea coal, or what may be termed the profitable sizes, has decreased from 77 to 61 per cent. In other words, the production of the profitable sizes has increased 36 per cent, while the production of the unprofitable sizes has increased nearly 200 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, 1880–1905.

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	248,803,293	278,659,689	305,397,001
1905	69,339,152	77,659,850	141,879,000	281,481,688	315,259,491	334,877,963

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	314,121,783	351,816,398	444,371,021
1905	350,820,840	392,919,341	476,756,963

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, 1889–1905.

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	34,160,730
1903	299,813,428	11,107,917	12,633,653	33,801,418
1904	296,142,355	16,519,043	7,876,463	31,278,537
1905	324,254,325	12,209,669	14,043,019	42,412,328

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	351,816,398	444,371,021	1.26	202	593,693
1905	392,919,341	476,756,963	1.21	212	626,315

PRODUCTION OF COAL IN THE UNITED STATES FROM THE EARLIEST TIMES TO THE CLOSE OF 1905.

So far as known, 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" on the Illinois River near the present city of Ottawa, Ill. The first actual mining of coal was in the Richmond basin, Va., about 70 years after Father Hennepin's discovery in Illinois, but the first records of production from the Virginia mines were for the year 1822, when, according to one authority, 54,000 tons were mined. Ohio probably ranks second in priority of production, as coal was discovered there in 1755, but the records of production date back only to 1838. The mining of anthracite in Pennsylvania began about 1790, and it is said that in 1807 55 tons were shipped to Columbia, Pa. Reports of the anthracite coal trade are usually begun with the year 1820, when 365 tons, 1 ton for each day of the year, were shipped to Philadelphia from the Lehigh region. Prior to this, however, in 1814, a shipment of 22 tons was made from Carbondale, also to Philadelphia, and in the following table the production is considered to have begun in that year. It is probable that the actual production prior to 1820 was between 2,500 and 3,000 tons.

From 1814 to the close of 1905 the total amount of coal produced in the United States has amounted to 5,970,773,571 short tons. More than 50 per cent of this, or over 3,340,000,000 tons, has been from Pennsylvania, the anthracite production in that State having amounted to 1,774,623,598 tons, while the bituminous output of Pennsylvania has amounted to 1,566,632,870 short tons. Illinois ranks second, with a total production of 553,071,059 tons, and Ohio third, with 432,895,299 tons; West Virginia, although not coming into existence as a separate State until 1863, ranks fourth, with a total production in 43 years of 342,816,606 tons. Alabama comes fifth, with 137,375,893 tons, and Maryland sixth, with 136,638,467 tons.

The following table gives the production in each State from the date of earliest record to the close of 1905:

Production of coal in the United States from 1814 to the close of 1905.

[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													3,000	
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	328												
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											12,000	
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	8,880	
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	

Production of coal in the United States from 1814 to the close of 1905—Continued.

Year.	Pennsylvania.	Virginia.	Kentucky.	Illinois.	Ohio.	Pennsylvania.	Missouri.	Indiana.	Alabama.	Tennessee.	Iowa.	Arkansas.	North Carolina.	Maryland.	Washington.
	Anthracite.					*Bituminous.*									
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	200,900	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
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	3,410,914	7,576,482	36,475,060	24,400,220	97,938,287	4,168,308	10,842,189	11,262,046	4,782,211	6,519,933	2,009,451	7,000	4,813,622	3,137,681
1905.....	77,659,850	4,275,271	8,432,523	38,434,363	25,552,950	118,413,637	3,983,378	11,895,252	11,866,069	5,963,396	6,798,609	1,934,673	1,557	5,108,539	2,864,926
	1,774,623,598	48,263,378	101,997,803	553,071,059	432,895,299	1,566,632,870	89,862,162	133,362,117	137,375,893	71,431,789	126,768,246	19,221,695	476,805	136,638,467	36,151,981

Production of coal in the United States from 1814 to the close of 1905.

[Short tons.]

Year.	Michigan.	Georgia.	California.	West Virginia.	Colorado.	Wyoming.	Kansas.	Utah.	Indian Territory.	Oregon.	Montana.	New Mexico.	Texas.	North Dakota.	Miscellaneous.[a]	Total.
1814																22
1815																50
1816																75
1817																100
1818																200
1819																350
1820																3,450
1821																1,322
1822																58,583
1823																68,563
1824																80,725
1825																117,988
1826																147,911
1827																172,151
1828																195,908
1829																240,086
1830																320,072
1831																337,942
1832																591,050
1833																731,657
1834																600,515
1835																824,854
1836																984,832
1837																1,253,651
1838																1,355,527
1839																1,560,360
1840															1,520	2,070,039
1841																2,291,141
1842																2,610,057
1843																3,060,874

1844																3,681,252
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	124,690	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

a From 1871 to 1888, inclusive, production reported in this column is due principally to colliery consumption, which in some years was estimated and not included in the distribution by States. Since 1888 small, irregular production from several unimportant sources has been included in this column.

Production of coal in the United States from 1814 to the close of 1905—Continued.

Year.	Michigan.	Georgia.	California.	West Virginia.	Colorado.	Wyoming.	Kansas.	Utah.	Indian Territory.	Oregon.	Montana.	New Mexico.	Texas.	North Dakota.	Miscellaneous.	Total.
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	*a* 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	*a* 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	961,718	414,083	*a* 87,196	24,570,826	7,401,343	4,429,491	5,266,065	1,574,521	2,820,666	65,648	*b* 1,562,853	1,048,763	901,912	226,511	....	301,590,439
1903	1,367,619	416,951	*a* 105,420	29,337,241	7,423,602	4,635,293	5,839,976	1,681,409	3,517,388	91,144	*b* 1,493,060	1,541,781	926,759	278,645	....	357,356,416
1904	1,342,840	383,191	*a* 79,582	32,406,752	6,658,355	5,178,556	6,333,307	1,493,027	3,046,539	111,540	*c* 1,362,399	1,452,325	1,195,944	271,928	....	351,816,398
1905	1,473,211	351,991	*a* 80,824	37,791,580	8,826,429	5,602,021	6,423,979	1,332,372	2,924,427	109,641	*c* 1,649,714	1,649,933	1,200,684	317,542	....	392,919,341
	10,460,747	7,429,188	5,001,632	342,816,606	91,766,882	65,431,781	77,828,980	15,117,024	33,342,157	1,639,680	20,907,997	17,731,760	11,484,006	2,130,809	38,911,160	5,970,773,571

a Includes Alaska's production. *b* Includes Idaho's production. *c* Production of Idaho and Nevada.

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 Standstone 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 of 70,807 square miles underlain by coal, and in 1905 it produced 212,830,030 short tons, or 67.5 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 1905 55,255,541 short tons, or 17.53 per cent of the total. The Western coal field, the third in productive importance, contains 94,076 square miles and produced in 1905 23,265,750 short tons, or 7.38 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 1905 19,303,188 short tons, or 6.13 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 1901 to 1905:

Coal fields of the United States and their production, 1901-1905.

	Area.	1901.	1902.	1903.	1904.	1905.
Anthracite.	*Sq. miles.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Pennsylvania	484	67,471,667	41,373,595	74,607,068	73,156,709	77,659,850
Colorado and New Mexico	16	66,869	93,937	72,731	72,074	74,823
Total	500	67,538,536	41,467,532	74,679,799	73,228,783	77,734,673
Bituminous.[a]						
Triassic:						
Virginia	270	12,000	16,206	18,084	2,100	....
North Carolina	800		23,000	17,309	7,000	1,557
Appalachian:						
Pennsylvania	15,800	82,305,946	98,574,367	103,117,178	97,938,287	118,413,637
Ohio	12,000	20,943,807	23,519,894	24,838,103	24,400,220	25,552,950
Maryland	510	5,113,127	5,271,609	4,846,165	4,813,622	5,108,539
Virginia	1,850	2,725,873	3,166,787	3,433,223	3,408,814	4,275,271
West Virginia	17,280	24,068,402	24,570,826	29,337,241	32,406,752	37,791,580
Eastern Kentucky	10,300	2,268,892	3,019,757	3,158,972	3,211,418	3,506,597
Tennessee	4,400	3,633,290	4,382,968	4,798,004	4,782,211	5,963,396
Georgia	167	342,825	414,083	416,951	383,191	351,991
Alabama	8,500	9,099,052	10,354,570	11,654,324	11,262,046	11,866,069
Total	70,807	150,501,214	173,274,861	185,600,161	182,606,561	212,830,030
Northern:						
Michigan	11,300	1,241,241	964,718	1,367,619	1,342,840	1,473,211
Central:						
Indiana	9,300	6,918,225	9,446,424	10,794,692	10,842,189	11,895,252
Western Kentucky	5,800	3,201,094	3,747,227	4,379,060	4,365,064	4,925,926
Illinois	42,900	27,331,552	32,939,373	36,957,104	36,475,060	38,434,363
Total	58,000	37,450,871	46,133,024	52,130,856	51,682,313	55,255,541
Western:						
Iowa	20,000	5,617,499	5,904,766	6,419,811	6,519,933	6,798,609
Missouri	23,000	3,802,088	3,890,154	4,238,586	4,168,308	3,983,378
Nebraska	3,200	....	....	....	....	....
Kansas	20,000	4,900,528	5,266,065	5,839,976	6,333,307	6,423,979
Arkansas	1,728	1,816,136	1,943,932	2,229,172	2,009,451	1,934,673
Indian Territory	14,848	2,421,781	2,820,666	3,517,388	3,046,539	2,924,427
Texas	11,300	1,107,953	901,912	926,759	1,195,944	1,200,684
Total	94,076	19,665,985	20,727,495	23,171,692	23,273,482	23,265,750
Rocky Mountain, etc.:						
North Dakota	28,620	166,601	226,511	278,645	271,928	317,542
Montana	32,000	1,396,081	1,560,823	1,488,810	1,358,919	1,643,832
Wyoming	16,500	4,485,374	4,429,491	4,635,293	5,178,556	5,602,021
Utah	2,000	1,322,614	1,574,521	1,681,409	1,493,027	1,332,372
Colorado	18,100	5,668,886	7,348,732	7,381,463	6,610,110	8,776,021
New Mexico	2,890	1,050,806	1,007,437	1,511,189	1,428,496	1,625,518
Idaho	....	....	2,030	4,250	3,330	5,782
Nevada	....	....	....	....	150	100
Total	100,110	14,090,362	16,149,545	16,981,059	16,344,516	19,303,188

[a] Includes brown coal or lignite, semianthracite, semibituminous, etc., and scattering lots of anthracite.

Coal fields of the United States and their production, 1901–1905—Continued.

	Area.	1901.	1902.	1903.	1904.	1905.
Bituminous.						
Pacific coast:	*Sq. miles.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Washington	450	2,578,217	2,681,214	3,193,273	3,137,681	2,864,926
Oregon	320	69,011	65,648	91,144	111,540	109,641
California	280	151,079	84,984	104,673	78,888	77,050
Alaska		1,300	2,212	747	694	3,774
Total	1,050	2,799,607	2,834,058	3,389,837	3,328,803	3,055,391
Total production, including colliery consumption		293,299,816	301,590,439	357,356,416	351,816,398	392,919,341

In the following table is presented a statement of the total production in each field from 1887 to the close of 1905:

Total production of each field, 1887–1905.

	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	182,606,561	1,342,840
1905	77,734,673	1 557	212,830,030	1,473,211

Total production of each field, 1887–1905—Continued.

	Bituminous.			
	Central.	Western.	Rocky Mountain, etc.	Pacific coast.
Area......square miles..	58,000	94,076	100,110	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	51,682,313	23,273,482	16,344,516	3,328,803
1905	55,255,541	23,265,750	19,303,188	3,055,391

The following table shows how the production in each of the six principal bituminous areas has developed since 1887 and how the percentages of the total produced by each during the last three years compare with one another. From this table it appears that the percentage of the total produced in the Appalachian district has increased from 63.11 in 1887 to 67.5 in 1905. The Central or Illinois-Indiana field has increased its percentage of the total from 16.50 to 17.53, and the Rocky Mountain field from 4.15 to 6.13. The Western field, which includes Iowa, Kansas, Missouri, Arkansas, Indian Territory, and Texas, however, which in 1887 contributed 11.49 per cent of the total, produced only 7.38 per cent in 1905. The following table also shows how the production of each field in 1905 compared with 1904 and with 1887:

Production of the six principal bituminous coal fields in 1887, 1901, 1902, 1903, 1904, and 1905, compared.

Field.	1887.		1901.		1902.		1903.	
	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	150,501,214	66.7	173,274,861	66.60	185,600,161	65.64
Central	14,478,883	16.50	37,450,871	16.6	46,133,024	17.73	52,130,856	18.43
Western	10,172,634	11.49	19,665,985	8.7	20,727,495	7.97	23,171,692	8.20
Northern	71,461	.08	1,241,241	.5	964,718	.37	1,367,619	.48
Rocky Mountain	3,646,280	4.15	14,090,362	6.2	16,149,545	6.21	16,981,059	6.01
Pacific coast	854,308	1.00	2,799,607	1.2	2,834,058	1.07	3,389,837	1.20

Production of the six principal bituminous coal fields in 1887, 1901, 1902, 1903, 1904, and 1905, compared—Continued.

Field.	1904.		1905.		Increase in 1905 over 1887.		Increase in 1905 over 1904.	
	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	182,606,561	65.53	212,830,030	67.50	156,941,942	280.8	29,815,830	16.33
Central	51,682,313	18.55	55,255,541	17.53	40,776,658	281.63	3,481,038	6.72
Western	23,273,482	8.35	23,265,750	7.38	13,093,116	128.81	*a* 7,732	*a* .03
Northern	1,342,840	.48	1,473,211	.47	1,401,750	1,961.56	130,371	9.71
Rocky Mountain	16,344,516	5.87	19,303,188	6.13	15,656,908	429.39	2,964,472	18.14
Pacific coast	3,328,803	1.19	3,055,391	.97	2,201,083	257.64	*a* 273,412	*a* 8.21

a Decrease.

COAL IN THE PHILIPPINE ISLANDS.

A report on the coal deposits of the Philippine Islands by Mr. H. L. Wigmore, first lieutenant, Corps of Engineers, was published in 1905 by the Bureau of Insular Affairs of the War Department. It contains also a special report by Mr. W. H. Smith, geologist, on the coal deposits of Batan Island.

According to the report of Mr. Smith, geologist of the mining bureau at Manila, there are three distinct coal horizons on Batan Island, but only one of these, the highest in the series, has been exploited commercially, though some exploratory work with drills has been done on the lower horizons. This exploratory work has shown that the more valuable coal is to be found in the lowest horizon, the total thickness of which is something over 300 feet. One drill hole shows 12 seams of coal, the thinnest being 6 inches, while the thickest is 3 feet 9 inches. From analyses and tests that were made on samples taken by Lieutenant Wigmore and those associated with him in the work, the coal is found to be superior to the Japanese coal, which would be its principal competitor.

In the opinion of Mr. Smith, the coal in the upper or middle horizon offers better opportunity for successful mining than either of the other two horizons. Three seams have been penetrated in a number of places by drill holes, while 7 prospect tunnels have also been driven on the crops. The two most important of the prospect tunnels are what are known as the "Urgera" mine on the old Spanish claim of the same name, and the San Francisco or Big Tree seam.

The character of the coal in both of these localities is much the same, but somewhat favorable to the Big Tree property. In driving this tunnel the coal was found to maintain a thickness of 6½ feet for about 30 feet, and it then pinched out by the roof coming down to meet the floor. This is not attributed to an entire disappearance of the coal, but it is believed to be what is known as a local "want." In the Urgera tunnel the coal was 14 feet in thickness, but here also a "want" was developed and was not penetrated.

In the mining of the Batan coal transportation is afforded by water, the outcrops being but a short distance from an excellent harbor, capable of accommodating vessels drawing 32 feet. Inland transportation would be impossible, nor is it desirable with the excellent facilities for water shipment.

Ample supplies of material for construction purposes and timber for use in the mines are available. Lieutenant Wigmore recommends that in the development and operation of the property Japanese miners should be employed. He gives detailed estimates as to expenses of mining the coal with comparison of its total cost with that of Japanese coal in the same markets. During his exploitation work Lieutenant

Wigmore and his assistants took numerous samples, the analyses of which are published in connection with this report. Samples from the San Francisco or Big Tree outcrop and from the seam some distance from the crop show the following compositions:

Composition of coal from Batan Island, P. I.

	San Francisco outcrop.	Big Tree seam.	
Moisture	6.90	5.80	6.00
Volatile matter	36.90	41.20	42.20
Fixed carbon	40.00	44.50	44.00
Ash	16.20	8.50	7.80
	100.00	100.00	100.00
Sulphur	.33	.43	.44

Accompanying Lieutenant Wigmore's report is a report from J. P. Dickinson, chief engineer of the steamer *Sacramento*, in which the results of tests made with Japanese and Batan coal are given. In each case tests were continued for a period of 6 hours steady steaming under the usual pressure of 110 pounds. The weight of the Japanese coal used during this test was 4,236¾ pounds. The ash from this coal amounted to 889.56 pounds. The test made under the same conditions and with same pressure on the Batan coal required 3,570 pounds. The ash from the Batan coal weighed 676 pounds. The relative quantity of soot given off by the two coals was, for Japanese 10 per cent and Batan 2 per cent. It is also slated that the Batan coal required less frequent cleaning of tubes than the Japanese coal. Engineer Dickinson states that the Batan coal is in every respect superior to the Japanese.

Another test made under the supervision of Mr. Sidney S. Mills, chief engineer on the U. S. army transport *Chu-Kong*, was conducted for a period of 60 hours. In this case the amount of coal consumed per hour was 580 pounds, or a total of 34,800 pounds. The amount of coal consumed per indicated horsepower per hour was 1.45, an exceedingly good record.

Lieutenant Wigmore also visited the coal deposits on the island of Polillo, but from his examination he regards the conditions at Batan far superior to Polillo. There are several outcrops of the coal exposed in creek beds, etc., and upon one of these a prospect drift was driven upon the bed for the purpose of taking out 20 tons of coal for trial and test. This bed was first supposed to be about 12 feet in thickness, but on opening up developed to be only 4 feet and maintained this thickness so far as the work had proceeded. An analysis of the coal made by Mr. Paul Fox at the civil government laboratory developed the following composition:

Composition of coal from Polillo Island, P. I.

Moisture	4.7
Volatile matter	43.5
Fixed carbon	50.1
Ash	1.7
	100.0
Sulphur	.28

The seam from which this was taken is composed of two distinct characteristics of coal, the lower 2 feet being quite hard, with a dull brownish fracture, and very dusty, while the upper 2 feet breaks up easily, with a black, lustrous fracture. Lieutenant Wigmore estimates that the amount of coal on Polillo Island is probably greater than that on Batan, but other conditions are in favor of the latter island.

During the spring of 1906 a sample of Batan coal was brought to Mr. M. R. Campbell, of the United States Geological Survey, from a mine near the military reservation on Batan Island. This sample is said to have been from the upper and newer horizon, and is different in quality from the one reported on by Lieutenant Wigmore. It appears to be a lignite or subbituminous coal, while the coal of the lower series, according to Lieutenant Wigmore, was bituminous. The sample brought to Mr. Campbell was analyzed at the Government laboratory of the Geological Survey coal-testing plant at St. Louis by Mr. F. M. Stanton, in charge of the laboratory. Mr. Stanton also made calorific determinations in the Mahler bomb calorimeter, which determination showed this sample to compare favorably with the subbituminous or black lignite coals of New Mexico and Wyoming. The ash is moderately low and the sulphur not sufficiently high to impair its usefulness for steam and domestic purposes. Although this sample had been subjected to a number of weathering conditions it reached the testing plant in what appeared to be approximately the condition in the mine and had not shown any signs of disintegration, but when subjected to air-drying process went rapidly to pieces. The composition of this coal, as determined by Mr. Stanton, is as follows:

Analysis of sample of Batan Island coal.

	Air-dried sample.	Sample as received.
Proximate:		
Moisture	7.06	22.21
Volatile combustible	43.94	36.77
Fixed carbon	43.44	36.36
Ash	5.56	4.65
Ultimate:		
Sulphur	1.36	1.14
Hydrogen	5.55	6.46
Carbon	62.91	52.66
Nitrogen	1.33	1.11
Oxygen	23.29	33.98
Ash	5.56	4.65
Calories	6,101	5,107
British thermal units	10,983	9,193

RANK OF COAL-PRODUCING STATES.

In the following tables the coal-producing States are arranged according to rank in 1904 and 1905, 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.

Among the 10 leading States it is observed that Indiana has supplanted Alabama as the fifth in quantity of production, though the latter still holds its old position with regard to the value of the product. Colorado has taken the place of Kentucky in the quantity of coal produced, and in the value of the output has outstripped both Iowa and Kansas and now ranks seventh in both particulars.

In the table for 1905 Pennsylvania is shown to have contributed, with the combined production of anthracite and bituminous coal, exactly 50 per cent of the total coal output of the United States. There have been, in fact, only 3 years in the last 65 in which Pennsylvania has not produced more than half of the coal mined in the United States. These were 1902, 1903, and 1904. In 1905 the output of anthracite in Pennsylvania was equal to 19.8 per cent of the total, while 30.2 per cent was from the bituminous mines of that State. Of the other more important coal-producing States, Illinois contributed 9.8 per cent, West Virginia 9.6 per cent, Ohio 6.5 per cent, and Alabama and Indiana each 3 per cent. These 6 States are credited with 82 per cent of the total production.

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	31.3
	Bituminous	97,938,287	27.8		Bituminous	94,428,219	21.3
2	Illinois	36,475,060	10.4	2	Illinois	39,941,993	9.0
3	West Virginia	32,406,752	9.2	3	West Virginia	28,647,014	6.4
4	Ohio	24,400,220	6.9	4	Ohio	26,579,738	6.0
5	Alabama	11,262,046	3.2	5	Alabama	13,480,111	3.0
6	Indiana	10,842,189	3.1	6	Indiana	12,004,300	2.7
7	Kentucky	7,576,482	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	7,868,192	1.8
11	Wyoming	5,178,556	1.5	11	Missouri	6,801,751	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	Teneseee	5,642,393	1.3
15	Virginia	3,410,914	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	2,921,911	.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	.4
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	271,928		25	North Dakota	389,052	
26	Oregon	111,540		26	California and Alaska	377,306	.2
27	California and Alaska	79,582	.1	27	Oregon	243,588	
28	Idaho	[a]3,480		28	Idaho	[a]13,730	
	Total	351,816,398	100.0		Total	444,371,021	100.0

[a] Includes production of Nevada.

Rank of coal-producing States in 1905, 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.
		Short tons.					
1	Pennsylvania: Anthracite	77,659,850	19.8	1	Pennsylvania: Anthracite	$141,879,000	29.8
	Bituminous	118,413,637	30.2		Bituminous	113,390,507	23.8
2	Illinois	38,434,363	9.8	2	Illinois	40,577,592	8.5
3	West Virginia	37,791,580	9.6	3	West Virginia	32,341,790	6.8
4	Ohio	25,552,950	6.5	4	Ohio	26,486,740	5.5
5	Indiana	11,895,252	3.0	5	Alabama	14,387,721	3.0
6	Alabama	11,866,069	3.0	6	Indiana	12,492,255	2.6
7	Colorado	8,826,429	2.3	7	Colorado	10,810,978	2.3
8	Kentucky	8,432,523	2.2	8	Iowa	10,586,381	2.2
9	Iowa	6,798,609	1.7	9	Kansas	9,350,542	2.0
10	Kansas	6,423,979	1.6	10	Kentucky	8,385,232	1.8
11	Tennessee	5,963,396	1.5	11	Wyoming	7,336,951	1.5
12	Wyoming	5,602,021	1.4	12	Tennessee	6,797,550	1.4
13	Maryland	5,108,539	1.3	13	Missouri	6,291,661	1.3
14	Virginia	4,275,271	1.1	14	Maryland	5,831,760	1.2
15	Missouri	3,983,378	1.0	15	Indian Territory	5,145,358	1.1
16	Indian Territory	2,924,427	.8	16	Washington	5,141,258	1.1
17	Washington	2,864,926	.7	17	Virginia	3,777,325	.8
18	Arkansas	1,934,673	.5	18	Arkansas	2,880,738	.6
19	New Mexico	1,649,933	.4	19	Montana	2,823,350	.6
20	Montana	1,643,832	.4	20	Michigan	2,512,697	.5
21	Michigan	1,473,211	.4	21	New Mexico	2,190,231	.5
22	Utah	1,332,372	.3	22	Texas	1,968,558	.4
23	Texas	1,200,684	.3	23	Utah	1,793,510	.4
24	Georgia and North Carolina	353,548	.1	24	Georgia and North Carolina	456,184	.1
25	North Dakota	317,542	.1	25	North Dakota	424,778	.2
26	Oregon	109,641		26	California and Alaska.	395,975	
27	California and Alaska.	80,824		27	Oregon	282,495	
28	Idaho	[a] 5,882		28	Idaho	[a] 17,846	
	Total	392,919,341	100.0		Total	476,756,963	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 productions, 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 or subbituminous. In the following table the production of these varieties of coal in 1904 and 1905 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 50,408 short tons mined in Colorado in 1905 and that 24,415 short tons were produced in New Mexico. Semianthracite coal is reported from Pennsylvania, Colorado, Indian Territory, Virginia, Montana, and Arkansas. Bituminous coal is produced in 27 States and Territories and forms by long odds the largest part of the total production. Semibituminous coal is produced in 14 States and Territories, with West Virginia first, followed in order by Pennsylvania, Maryland, Montana, Virginia, and Colorado. Wyoming leads in the production of lignite or subbituminous coals, nearly 70 per cent of the production of that State being so classed. It should be stated in this connection that it is believed that the classification of the so-called black lignites of the Rocky Mountain States as lignites is erroneous, as they are entirely distinct from the real lignites or brown coals. They are not lignites in chemical composition, in color, or in physical characteristics. They lie between the lignites or brown coals and the true bituminous coals, and in order that a proper distinction may be made, the term "subbituminous" has been adopted by the Geological Survey as properly applicable to them. It is in this variety that Wyoming leads, with Colorado second and New Mexico third. A part of the California and Oregon product should also be included under this head. The principal producers of true lignite or brown coals are Texas and North Dakota. The comparatively small production of cannel coal is from 9 States, of which West Virginia and Kentucky are the principal ones. West Virginia is also credited with nearly all of the splint coal production, while Indiana is the leading producer of block coal.

Classification of the coal product of the United States in 1904, by States and Territories.

[Short tons.]

State or Territory.	Bituminous.	Anthracite.	Semi-bituminous.	Lignite and sub-bituminous.	Semi-anthracite.	Block.	Splint.	Cannel.	Total.
Pennsylvania	95,712,513	72,862,403	2,219,967		294,306			5,807	171,094,996
Illinois	36,389,276		83,278			2,506			36,475,060
West Virginia	24,792,865		5,395,364			107,373	1,921,416	[a]189,704	32,406,752
Ohio	24,378,906					4,876	7,850	8,588	24,400,220
Alabama	[b]11,255,566					6,480			11,262,046
Indiana	9,679,086					[c]1,130,753		32,350	10,842,189
Kentucky	7,394,197		37,000			[d]5,000	7,882	[e]132,403	7,576,482
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	1,261,616		233,585	3,683,355					5,178,556
Maryland	3,386,122		1,427,500						4,813,622
Tennessee	4,612,308		157,703			12,200			4,782,211
Missouri	4,023,201		64,071			73,515		7,521	4,168,308
Virginia	2,568,831		811,422		30 661				3,410,914
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	609,886		721,497	25,836	1,000			700	1,358,919
Michigan	1,342,840								1,342,840
Texas	774,315			352,878				68,751	1,195,944
Georgia	111,335		271,856						383,191
North Dakota				271,928					271,928
Oregon				111,540					111,540
California				78,888					78,888
North Carolina	7,000								7,000
Idaho[f]	1,230			2,250					3,480
Alaska			224	470					694
Total	255,297,936	72,934,477	12,060,019	6,366,508	1,373,192	1,388,137	1,937 178	458,951	351,816,398

[a] Includes 166,904 tons of semicannel coal.
[b] Includes 6,455 tons of semicannel coal.
[c] Includes 264,731 tons of semiblock coal.
[d] Includes 3,500 tons of semiblock coal.
[e] Includes 51,811 tons of semicannel coal.
[f] Includes Nevada's production.

Classification of the coal product of the United States in 1905, by States and Territories.

[Short tons.]

State or Territory.	Bituminous.	Anthracite.	Semi-bituminous.	Lignite and sub-bituminous.	Semi-anthracite.	Block.	Splint.	Cannel.	Total.
Pennsylvania	115,435,386	77,352,783	2,974,432		307,067			3,819	196,073,487
Illinois	38,354,332		80,031						38,434,363
West Virginia	29,318,610		5,467,415			152,694	2,595,850	a 257,011	37,791,580
Ohio	25,547,913					1,875	800	2,362	25,552,950
Indiana	11,093,358					b 769,419		32,475	11,895,252
Alabama	11,866,069								11,866,069
Colorado	7,084,882	50,408	366,749	1,312,390	12,000				8,826,429
Kentucky	8,142,035		61,744			1,800	73,139	c 153,805	8,432,523
Iowa	6,768,389					14,608		15,612	6,798,609
Kansas	6,417,479					6,500			6,423,979
Tennessee	5,960,396					3,000			5,963,396
Wyoming	1,341,406		238,388	4,022,227					5,602,021
Maryland	3,473,501		1,635,038						5,108,539
Virginia	3,408,880		816,592		49,799				4,275,271
Missouri	3,979,402					1,476		2,500	3,983,378
Indian Territory	2,554,191				370,236				2,924,427
Washington	2,563,002		133,749	168,175					2,864,926
Arkansas	1,409,937		88,606		436,130				1,934,673
New Mexico	1,161,028	24,415		464,490					1,649,933
Montana	614,003		1,013,871	14,808	1,000			150	1,643,832
Michigan	1,473,211								1,473,211
Utah	1,326,619		4,728	1,025					1,332,372
Texas	730,651			391,533				78,500	1,200,684
Georgia	93,588		258,403						351,991
North Dakota				317,542					317,542
Oregon				109,641					109,641
California				77,050					77,050
Idaho d	1,502		100	4,280					5,882
North Carolina	1,557								1,557
Alaska	450			3,324					3,774
Total	290,121,177	77,427,606	13,139,846	6,886,485	1,176,232	951,372	2,669,789	546,234	392,919,341

a Includes 238,844 tons of semicannel coal. b Includes 52,296 tons of semiblock coal. c Includes 15,397 tons of semicannel coal. d Includes Nevada's production.

LABOR STATISTICS.

In the following tables are shown the number of men employed and the average time worked in the coal mines of the United States during the last 5 years, by States, and the total number employed in the anthracite and bituminous mines, with the average working time, since 1890. The total number of men employed in 1905 was 626,174, against 593,693 in 1904 and 566,260 in 1903. Of the total number of employees in 1905, 460,768, or nearly 75 per cent, were bituminous mine workers, and 165,406, or something over 25 per cent, were employed in the anthracite mines. The average number of days worked in the anthracite mines was 215, and in the bituminous mines 211. This average for the anthracite mine workers was the highest recorded in the 16 years that these statistics have been obtained, and was probably due to the efforts put forth by the operating companies to lay in a large supply of coal in anticipation of a strike when the award of the Anthracite Strike Commission expired in the spring of 1906. With the exception of 1904, the average time made by the bituminous mine workers in 1905, notwithstanding the enormous production in that year, was the lowest since 1898.

Statistics of labor employed in coal mines of the United States, 1901–1905, by States.

State or Territory.	1901.		1902.		1903.		1904.		1905.	
	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	236	17,370	256	16,439	228	21,438	216	17,811	225	19,595
Arkansas	223	3,144	188	3,595	223	4,157	165	4,580	177	4,192
California	289	428	a 302	a 217	a 301	a 208	a 282	a 168	a 294	a 144
Colorado	253	8,870	261	8,956	245	9,229	261	8,123	255	11,020
Georgia	b 291	b 791	b 312	b 795	b 296	b 730	b 223	b 906	b 266	b 816
Idaho	.....	.....	74	20	197	32	c 112	c 32	c 107	c 37
Illinois	220	41,880	226	47,411	228	50,596	213	54,685	201	58,053
Indiana	194	12,968	205	15,457	197	17,017	177	19,587	151	25,323
Indian Territory	208	6,706	232	5,574	247	7,704	199	8,487	188	7,712
Iowa	218	12,653	227	12,434	226	14,162	213	15,629	209	15,113
Kansas	224	9,928	220	9,461	215	10,924	213	12,198	212	11,926
Kentucky	213	10,307	209	13,727	207	14,354	197	14,235	200	14,685
Maryland	262	5,333	242	5,827	219	5,859	226	5,671	252	5,948
Michigan	247	2,276	171	2,344	222	2,768	183	3,549	186	3,696
Missouri	223	9,871	202	9,742	215	9,544	206	10,137	194	8,962
Montana	231	2,158	270	1,938	254	2,155	243	2,505	243	2,181
New Mexico	224	2,478	217	1,849	260	1,789	228	1,849	234	2,108
North Dakota	198	280	213	402	198	486	192	554	187	626
Ohio	198	32,111	200	38,965	194	41,936	175	43,634	176	43,399
Oregon	228	187	234	265	258	235	149	334	242	316
Pennsylvania bituminous	230	101,904	248	112,630	235	129,265	196	135,100	231	143,629
Tennessee	228	9,046	230	8,750	227	9,961	217	10,416	222	12,198
Texas	264	3,051	267	2,369	242	2,380	220	2,921	238	3,008
Utah	259	1,712	259	1,826	248	1,925	294	1,374	247	1,361
Virginia	279	4,152	293	3,912	267	5,608	238	5,165	241	5,730
Washington	276	4,545	275	4,404	285	4,768	243	5,287	227	4,765
West Virginia	219	30,935	205	35,500	210	41,554	197	47,235	209	48,389
Wyoming	248	5,151	248	5,250	252	4,993	262	5,660	236	5,977
Total	225	340,235	230	370,059	225	415,777	202	437,832	211	460,909
Pennsylvania anthracite	196	145,309	116	148,141	206	150,483	200	155,861	215	165,406
Grand total	216	485,544	197	518,200	220	566,260	202	593,693	212	626,315

a Includes Alaska. b Includes North Carolina. c Includes Nevada.

Statistics of labor employed in coal mines of the United States, 1890–1905.

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	437,832
1905	215	165,406	211	460,909

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 1905. 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 1905 the average production per man in the anthracite region was 470 short tons for the year and 2.18 tons for the day, while the bituminous production shows an average of 684 tons per man for the year and 3.24 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 1905. It will be observed that the daily efficiency record in the anthracite region has declined about 10 per cent in the last 2 years, while that of the workers in the bituminous regions has increased about 8 per cent. But it will also be observed that during the last three years the number of days worked in the anthracite mines is considerably above the average, as is also the tonnage per man per year. These are undoubtedly due to the previously mentioned policy, adopted by the anthracite operators in recent years, of allowing discounts during the spring and summer from the regular circular prices, which encourages the purchase of coal at that time, and its storage in the cellars of consumers, thus giving more steady employment to the mine workers throughout the year, and avoiding in large degree the shutting down of the mines during the summer. The increased production of bituminous coal per man per day is accounted for in the more extended development of the use of undercutting machines, the statistics of which are discussed in the subsequent pages of this report.

Production of coal according to number of persons employed, 1890–1905.

Year.	Anthracite. Men employed.	Days worked.	Average tonnage per man per day.	Average tonnage per man per year.	Bituminous. 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	437,832	202	3.15	637
1905	165,406	215	2.18	470	460,909	211	3.24	684

In connection with the statistics of labor employed in the bituminous coal mines of the United States, the Geological Survey has during the past three or four years included on its schedules an inquiry as to the number of hours constituting a day's work. It will be remembered that by the terms of the award of the Anthracite Coal Strike Commission, which terminated on 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 the coal is mined by contract at so much per ton, or mine car, by yardage, or by other basis of measurement of the coal mined. By an agreement between the operators and the representatives of the mines, the award of the Strike Commission has been extended without change for another term of 3 years, or until March 31, 1909.

The statistics for the bituminous mines show that in the States where the miners are more thoroughly organized the 8-hour day prevails. Throughout the Central and Western fields, for instance, and in Ohio and Michigan by far the larger number of mines have worked 8 hours a day for the last 3 years. In Pennsylvania there were, in 1905, 60,297 men employed at 669 mines that worked 8 hours, against 77,960 men at 637 mines in 1904. There were, however, 48 mines, employing 22,051 men, that did not report the number of hours per day, and probably most of them should be included with the 8-hour mines, as the number of men reported as working 9 and 10 hours and the number of mines reporting them were about the same in both years. The States in which the 10-hour day prevails are West Virginia, Alabama, Colorado, Maryland, Wyoming, and Virginia. Kentucky and Tennessee are divided principally between 9 and 10 hours.

There are so many influences affecting the production of coal in the different States that it has not been possible to draw any reliable conclusions in regard to the effect of the length of the day's work upon the intensity of labor, though some averages are presented in the following pages which may or may not indicate the tendency in this particular. Principal among the influences is the rapidly increasing use of mining machinery among the bituminous mines and other mechanical equipment which has for its object the cheapening of production and increasing the output per man. The most striking facts presented have been the decreased production per man per day in the anthracite region, where mining machines are not employed, and the increased output per man per day in the bituminous districts, which is due in most part to undercutting machinery.

In the following tables the figures are given for the more important States, the ones omitted having too small a production to be of any interest in this report.

Number of hours to the working day in 1904, by States.

State or Territory.	Less than 8 hours.		8 hours.		9 hours.		10 hours.		More than 10 hours.	
	Mines.	Men.	Mines.	Men.	Mines.	Men.	Mines.	Men.	Mines.	Men.
Alabama			17	876	50	5,763	50	8,409		
Arkansas	1	7	42	4,472						
California					2	22	4	146		
Colorado			55	2,058	11	432	57	5,583		
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 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			[a] 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] 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.

Number of hours to the working day in 1905, by States.

State or Territory.	8 hours.		9 hours.		10 hours.		All others.[a]	
	Mines.	Men.	Mines.	Men.	Mines.	Men.	Mines.	Men.
Alabama	24	1,069	32	3,570	65	11,279	25	3,677
Arkansas	45	4,146	1	16	....	....	2	30
Colorado	61	3,660	4	189	40	6,551	25	620
Illinois	583	56,296	8	64	6	405	40	1,288
Indiana	271	24,484	2	24	3	15	26	800
Indian Territory	59	7,544	....	....	3	108	3	60
Iowa	186	13,569	5	56	3	22	26	1,466
Kansas	121	11,004	6	129	5	54	23	427
Kentucky	50	3,445	52	4,050	94	5,995	35	1,195
Maryland	2	70	2	60	39	5,385	11	433
Michigan	23	3,327	....	....	....	....	5	369
Missouri	194	8,096	6	70	4	25	27	771
Montana	23	[b]1,707	....	....	2	6	2	468
New Mexico	4	83	5	92	12	1,923	2	10
North Dakota	8	79	7	50	20	374	14	90
Ohio	524	42,262	7	527	4	27	56	685
Oregon	2	109	1	14	2	193	....	....
Pennsylvania	669	60,297	226	26,090	179	31,314	74	25,928
Tennessee	8	1,026	63	5,813	33	4,463	11	896
Texas	11	1,442	3	[b]125	13	1,135	7	306
Utah	13	1,352	....	....	2	6	2	3
Virginia	2	522	7	591	25	3,999	5	618
Washington	18	3,644	1	28	8	353	6	740
West Virginia	49	3,532	161	14,387	251	25,731	52	4,739
Wyoming	2	8	2	456	26	5,492	4	21
Total	2,952	252,673	601	56,401	839	104,855	483	45,640

[a] Including mines not reporting hours per day. [b] Including day men who work 10 hours.

In the following table is presented a statement of the average production per man per day and per year compared with the average number of days worked by each man and the hours per day reported by the majority of mines in the important coal-producing States during the last 3 years. It is not claimed that this statement indicates accurately the effect the number of hours per day exerts upon the intensity of labor, because the conditions vary materially in the different States. In Utah, for instance, where 8 hours is the prevailing length of the labor day, the average tonnage per man is among the highest in all 3 years, and this State furnishes the best record of all in both respects in 1904 and 1905, while Wyoming, Colorado, and Maryland, which are 10-hour per day States, are close rivals of Utah. But if we take the averages as obtained from this table, the results appear to be in favor of the longer working day. Twenty-two States are included in the table. In 9 of these (excluding Pennsylvania anthracite and including only the bituminous production) the majority of the mines are worked either 9 or 10 hours and in 13 the 8-hour day prevails. The average of the average tonnages per man in the States working the longer day in 1905 was 730.6 tons for the year and 3.16 tons per day, while in the 8-hour States the corresponding figures were 580.8 tons and 2.81 tons. Moreover, it appears that the men who work 10 hours per day make more days in the year. In Colorado, for instance, in 1905 the average number of days worked was 255, in Maryland 252, in Virginia 247, and in Wyoming 236. The highest averages among the 8-hour States were 247 days made in Utah and 243 days in Montana. The average number of days made in the 9 States working 9 or 10 hours was 230, while in the 13 8-hour States it was 203. The returns from Washington show that the mines in that State worked 9 and 10 hours in 1903 and 8 hours in 1904 and 1905. The miners worked more days in 1903 than in either of the later years and the average total production per man was larger in 1903, while the average daily production per man was 2.35 tons in 1903, 2.44 tons in 1904, and 2.65 tons in 1905.

Average production per man compared with hours worked per day, and average number of days per year in 1903, 1904, and 1905.

State or Territory.	1903.				1904.				1905.			
	Number of hours per day.	Days worked.	Average tonnage.		Number of hours per day.	Days worked.	Average tonnage.		Number of hours per day.	Days worked.	Average tonnage.	
			Per year.	Per day.			Per year.	Per day.			Per year.	Per day.
Alabama	9 and 10	228	543.6	2.38	9 and 10	216	632.3	2.93	9 and 10	225	605.6	2.69
Arkansas	8	223	536.2	2.40	8	165	438.7	2.66	8	177	461.5	2.60
Colorado	10	245	804.4	3.28	10	261	819.7	3.14	10	255	800.9	3.14
Illinois	8	228	731.0	3.21	8	213	667.0	3.13	8	201	662.1	3.29
Indiana	8	197	634.3	3.22	8	177	553.5	3.13	8	151	469.7	3.11
Indian Territory	8	247	457.0	1.85	8	199	359.9	1.80	8	188	379.2	2.02
Iowa	8	226	453.3	2	8	213	417.2	1.96	8	209	449.9	2.15
Kansas	8	215	534.6	2.49	8	213	519.2	2.44	8	212	538.7	2.54
Kentucky	[a] 10	207	525.2	2.54	8, 9, and 10	197	532.2	2.70	9 and 10	200	574.2	2.87
Maryland	10	219	827.1	3.78	10	226	848.8	3.76	10	252	858.9	3.41
Michigan	8	222	494.1	2.23	8	183	378.4	2.07	8	186	398.6	2.14
Missouri	8	215	444.1	2.07	8	206	411.2	2.00	8	194	444.5	2.29
Montana	9	254	691.0	2.72	9	243	542.5	2.23	8	243	753.7	3.10
New Mexico	10	260	862.0	3.31	10	228	785.5	3.45	10	234	782.7	3.34
Ohio	8	194	592.0	3.05	8	175	559.2	3.20	8	176	588.8	3.35
Pennsylvania:												
Anthracite	9	206	495.8	2.41	9	200	469.4	2.35	9	215	469.5	2.18
Bituminous	[b] 8	235	798.0	3.40	[c] 8	196	724.9	3.70	8	231	824.4	3.57
Tennessee	9 and 10	227	482.0	2.12	9 and 10	217	459.1	2.12	9 and 10	222	488.9	2.20
Utah	9	248	873.0	3.52	8	294	1,086.6	3.70	8	247	979.0	3.96
Virginia	10	267	615.0	2.30	10	238	660.4	2.77	10	241	746.1	3.10
Washington	9 and 10	285	670.0	2.35	8	243	593.5	2.44	8	227	601.2	2.65
West Virginia	9 and 10	210	706.0	3.36	9 and 10	197	686.1	3.48	9 and 10	209	781.0	3.74
Wyoming	10	252	928.4	3.68	10	262	914.9	3.49	10	236	937.3	3.97

[a] Represents 50 per cent of employees; the other 50 per cent about evenly divided between 8 and 9 hours.
[b] Represents 50 per cent of employees; the other 50 per cent about evenly divided between 9 and 10 hours.
[c] Represents 60 per cent of employees; the other 40 per cent about evenly divided between 9 and 10 hours.

LABOR TROUBLES.

There have been few years in the coal-mining history of the United States in which there was less time lost through labor disaffections than is recorded in the statistics for 1905. The most serious trouble experienced was in Illinois, and was the result of the enactment of what is known as the shot-firers' law. This law, which was highly obnoxious to the operators, required the employment of additional men for firing the shots placed by the miners, and incurred, therefore, an extra expense, which the operators in a number of cases refused to pay, claiming it was a violation of the agreement that the expenses of mining coal were not to be increased by any action of the miners, and that this legislation had been secured at the instance of the miners' union. A number of strikes resulted, and as a serious disturbance of the peaceful conditions which had existed in Illinois for several years was threatened, the matter was submitted to the arbitrament of Judge George Gray, who had been chairman of the Anthracite Coal Strike Commission. Judge Gray decided that the expenses should be equally divided between the miners and the operators. Work was resumed when the arbitration was decided upon and the rest of the year was comparatively free from strike suspensions. The number of men on strike in Illinois during the year was 15,289, or 47 per cent of the total number of men in bituminous mines idle on account of strikes for the United States. These 15,289 men were idle an average of 21 days, the total number of working days lost by them amounting to 321,967, or 42 per cent of the entire time lost by strikes in all the bituminous mines of the country. Outside of Illinois the principal losses of time by reason of strikes were in Pennsylvania, where 5,686 men were idle an average of 33 days; in Ohio, where 3,250 men lost an average of 15 days; in Kentucky, where 923 men lost an average of 68 days; in Montana, where at one mine 200 men were on strike for 180 days, and in Alabama, where the strike inaugurated in 1904 is still officially in effect. In Iowa and Kansas there were comparatively large numbers of men on strike, but the time lost in each of the States was insignificant.

The aggregate number of men on strike in the bituminous coal mines of the United States in 1905 was 32,544. The average time lost by each was 23 days, and the total time lost amounted to 762,749 days, or 0.8 per cent of the total time made by the 460,909 employees in the bituminous mines. In the anthracite fields of Pennsylvania the men on strike numbered 4,998 and the average time lost was 6.8 days.

The statistics of labor troubles in the United States during 1904 and 1905, by States are shown in the following tables:

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 bituminous	75,433	3,348,727	44
Pennsylvania anthracite	2,228	34,103	15
Grand total	77,661	3,382,830	44

Statistics of labor strikes in the coal mines of the United States in 1905.

State or Territory.	Number of men on strike.	Total days lost.	Average number of days lost per man.
Alabama	667	33,262	50
Arkansas	625	7,806	12
Illinois	15,289	321,967	21
Indiana	981	12,528	13
Indian Territory	397	3,509	9
Iowa	1,774	10,353	6
Kansas	1,482	14,686	10
Kentucky	923	62,651	68
Missouri	435	6,788	16
Montana	200	36,000	180
Ohio	3,250	49,495	15
Pennsylvania	5,686	186,250	33
Tennessee	150	4,770	32
Texas	25	375	15
Utah	6	6	1
West Virginia	462	12,111	26
Wyoming	192	192	1
Total bituminous	32,544	762,749	23.4
Pennsylvania anthracite	4,998	33,986	7
Grand total	37,542	796,735	21

A summary of the statistics of strikes in the coal mines of the United States since 1899 is given in the following table. It will be observed that in only one year (1901) were the number of men on strike and the total lost time less than they were in 1905, and even in this case the percentage of the time lost to the total time worked was in favor of 1905.

Summary of labor strikes in the coal mines of the United States, 1899–1905.

Year.	Number of men on strike.	Total working days lost.	Average number of days lost per man.
1899	45,981	2,124,154	46
1900	131,973	4,878,102	37
1901 [a]	20,593	733,802	35
1902	200,452	16,672,217	83
1903 [a]	47,481	1,341,031	28
1904	77,661	3,382,830	44
1905	37,542	796,735	21

[a] Bituminous mines only.

COAL MINED BY MACHINES.

One of the most notable features presented by the statistics of bituminous-coal production in the United States during the year 1905, aside from the unprecedented increase in output, is the growth shown in the use of mining machines and in the amount of tonnage won with them. In the report for 1904 comment was made on the fact that the returns for that year showed a decided gain in the number of mining machines in use, while the increase in the production of machine-mined coal was comparatively unimportant. No such condition is exhibited in the statistics for 1905. In fact, the percentage of increase in the number of machines and in the production of machine-mined coal in 1905 over 1904 was greater than the percentage of increase in the total production. It is also shown that whereas the average output for each machine in use decreased from 11,712 short tons in 1903 to 10,258 tons in 1904, it increased again to 11,258 tons in 1905. This bears out the statement made in the report for 1904, that a large number of machines were installed in the latter part of that year, too late, in fact, to add materially to the production of machine-mined coal.

The total quantity of coal produced by the use of machines in 1905 was 103,396,452 short tons, compared with 78,606,997 short tons in 1904 and 77,974,894 tons in 1903. The increase in 1905 over 1904 was 24,789,455 short tons, or 31.5 per cent, while that of 1904 over 1903 was only 623,103 tons, or 0.81 per cent. The number of machines in use increased from 6,658 in 1903 to 7,663 in 1904 and to 9,184 in 1905. The increase in 1904 was 1,005, or 15.1 per cent, and the increase in 1905 was 1,513, or 19.7 per cent.

The percentage of the machine-mined tonnage to the total production in the States in which machines are used 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; in 1904, 28.78, and in 1905, 33.69.

Of the 9,184 machines in use in 1905, 5,525, or 60.1 per cent, were of the pick or puncher type; 3,557, or 38.7 per cent, were chain-breast machines, and 102, or 1.2 per cent, were long wall.

In the number of machines in use and in the amount of machine-mined tonnage, as in the total production of coal, Pennsylvania stands far in the lead, with 46.3 per cent of the number of machines and 47.7 per cent of the machine-won product in 1905. The amount of coal mined by machines in Pennsylvania increased from 35,174,613 short tons in 1904 to 49,335,660 short tons in 1905. West Virginia ranks second in the number of machines in use, with 1,105, closely followed by Ohio, with 1,041. The position of these 2 States is reversed in the amount of coal mined by machines, Ohio's production by machines in 1905 being 16,888,417 short tons, while West Virginia's was 12,504,301 tons. Ohio stands first in the percentage of machine-mined coal to the total product. Illinois, the second State in coal-producing importance, ranks fourth in the production by the use of machines. Kentucky, the eighth in rank among the coal-producing States, takes fifth place in the number of machines used and machine tonnage and second in the percentage of the machine-mined coal to the State total. Indiana is a close rival to Kentucky in the use of mining machines. The 6 States mentioned contribute over 90 per cent of the total machine-mined coal.

The statistics in regard to the coal mined by machines during the last 5 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, 1901–1905.

State or Territory.	Number of machines in use.					Number of tons mined by machines.				
	1901.	1902.	1903.	1904.	1905.	1901.	1902.	1903.	1904.	1905.
Alabama	82	66	98	141	213	289,051	300,670	577,317	741,170	1,584,942
Arkansas	20	7				102,220	8,989			
Colorado	62	98	157	125	121	319,678	857,279	1,270,221	945,965	1,247,687
Georgia					6					11,684
Illinois	464	508	553	643	882	5,774,639	7,112,039	7,381,027	7,110,902	8,697,547
Indiana	256	269	329	403	506	1,852,058	2,421,342	3,334,961	3,613,532	4,207,246
Indian Territory	47	23	36	18	29	177,233	119,195	73,304	42,594	40,203
Iowa	53	31	10	39	32	110,980	110,489	55,085	175,742	186,224
Kansas	4	6	5	5	10	37,979	48,000	9,876	10,600	19,101
Kentucky	237	318	308	453	527	2,254,711	3,091,626	2,843,805	3,595,513	4,409,054
Maryland	15	25	36	38	42	177,724	252,753	401,144	484,373	468,822
Michigan	31	58	46	85	106	177,969	196,248	180,943	310,007	432,266
Missouri	24	20	33	31	30	153,879	223,969	311,602	376,505	375,194
Montana	70	65	63	57	58	748,981	691,669	693,504	482,924	752,665
New Mexico	6	17	12	12		2,700	71,744	105,000	100,000	
North Dakota	7	10	9	9	9	43,574	89,838	115,222	125,097	97,789
Ohio	376	559	724	865	1,041	9,908,316	12,094,641	14,007,326	13,983,647	16,888,417
Pennsylvania	2,058	2,620	3,310	3,645	4,254	29,591,368	35,058,038	37,146,253	35,174,613	49,335,660
Tennessee	21	38	51	85	89	220,573	303,995	304,602	440,618	479,471
Texas	8	8	8	9	8	22,420	25,500	29,000	33,154	22,400
Utah	13	13	13	9		14,738	74,502	75,000	34,054	
Virginia	6	11	10	18	35	233,275	132,709	82,040	245,536	399,029
Washington	4					6,500				
West Virginia	403	579	788	901	1,105	4,817,943	5,738,045	8,193,840	9,526,749	12,504,301
Wyoming	74	69	59	72	81	804,826	588,302	783,822	1,053,702	1,236,759
Total	4,341	5,418	6,658	7,663	9,184	57,843,335	69,611,582	77,974,894	78,606,997	103,396,452

Bituminous coal mined by machines in the United States, 1901-1905—Continued.

State or Territory.	Total tonnage of States using mining machinery.					Percentage of total product mined by machines.				
	1901.	1902.	1903.	1904.	1905.	1901.	1902.	1903.	1904.	1905.
Alabama	9,099,052	10,354,570	11,654,324	11,262,046	11,866,069	3.17	2.90	4.95	6.58	13.36
Arkansas	1,816,136	1,943,932				5.62	.46			
Colorado	5,700,015	7,401,343	7,423,602	6,658,355	8,326,429	5.60	11.58	17.11	14.21	14.14
Georgia					351,991					3.32
Illinois	27,331,552	32,939,373	36,957,104	36,475,060	38,434,363	21.12	21.59	19.97	19.50	22.63
Indiana	6,918,225	9,446,424	10,794,692	10,842,189	11,895,252	26.77	25.63	30.90	33.33	35.37
Indian Territory	2,421,781	2,820,666	3,517,388	3,046,539	2,924,427	7.31	4.23	2.08	1.40	1.37
Iowa	5,617,499	5,904,766	6,419,811	6,519,933	6,798,609	1.97	1.87	.86	2.70	2.74
Kansas	4,900,528	5,266,065	5,839,976	6,333,307	6,423,979	.77	.91	.17	.17	.30
Kentucky	5,469,986	6,766,984	7,538,032	7,576,482	8,432,523	41.21	45.69	37.73	47.46	51.44
Maryland	5,113,127	5,271,609	4,846,165	4,813,622	5,108,539	3.47	4.28	8.28	10.06	9.18
Michigan	1,241,241	964,718	1,367,619	1,342,840	1,473,211	14.33	20.34	13.23	23.09	29.34
Missouri	3,802,088	3,890,154	4,238,586	4,168,308	3,983,378	4.04	5.76	7.35	9.03	9.42
Montana	1,396,081	1,560,823	1,488,810	1,358,919	1,643,832	53.64	44.31	46.58	35.54	45.79
New Mexico	1,086,546	1,048,763	1,541,781	1,452,325		.24	6.84	9.40	6.89	
North Dakota	166,601	226,511	278,645	271,928	317,542	26.15	39.66	41.35	46.00	30.80
Ohio	20,943,807	23,519,894	24,838,103	24,400,220	25,552,950	47.26	51.42	56.39	57.31	66.10
Pennsylvania	82,305,946	98,574,367	103,117,178	97,938,287	118,413,637	35.95	35.57	36.02	35.92	41.66
Tennessee	3,633,290	4,382,968	4,798,004	4,782,211	5,963,396	6.07	6.94	6.35	9.21	8.04
Texas	1,107,953	901,912	926,759	1,195,944	1,200,684	2.02	2.83	3.13	2.77	1.86
Utah	1,322,614	1,574,521	1,681,409	1,493,027		1.11	4.81	4.46	2.28	
Virginia	2,725,873	3,182,993	3,451,307	3,410,914	4,275,271	8.55	4.17	2.38	7.20	9.33
Washington	2,578,217					.25				
West Virginia	24,068,402	24,570,826	29,337,241	32,406,752	37,791,580	20.01	23.35	27.93	29.40	33.09
Wyoming	4,485,374	4,429,491	4,635,293	5,178,556	5,602,021	17.94	13.10	16.91	20.35	22.08
Total	225,251,934	256,943,673	276,691,829	272,927,764	307,279,683	a 25.68	a 27.09	a 28.18	a 28.80	a 33.69

a Average.

In the following table are shown the number and kinds of machines in use in each State in 1904 and 1905:

Number and kinds of machines in use in 1904 and 1905.

State or Territory.	1904.				1905.			
	Pick.	Chain-breast.	Long-wall.	Total.	Pick.	Chain-breast.	Long-wall.	Total.
Alabama	119	22		141	171	42		213
Colorado	67	56	2	125	74	42	5	121
Georgia					6			6
Illinois	541	102		643	758	123	1	882
Indiana	139	263	1	403	142	362	2	506
Indian Territory	8	10		18	25	4		29
Iowa	11	10	18	39	9	9	14	32
Kansas	3		2	5	10			10
Kentucky	336	112	5	453	381	144	2	527
Maryland	38			38	42			42
Michigan	84	1		85	90	16		106
Missouri		1	30	31		2	28	30
Montana	56	1		57	55	3		58
New Mexico	2	10		12				
North Dakota	1	8		9		9		9
Ohio	88	777		865	128	878	35	1,041
Pennsylvania	2,455	1,175	15	3,645	3,020	1,232	2	4,254
Tennessee	71	14		85	77	12		89
Texas	6		3	9	5		3	8
Utah	7		2	9				
Virginia	3	15		18	10	25		35
West Virginia	410	491		901	473	628	4	1,105
Wyoming	46	26		72	49	26	6	81
Total	4,491	3,094	78	7,663	5,525	3,557	102	9,184

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 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	7,663	78,606,997	10,258
1905	9,184	103,396,452	11,258

While there are a few exceptions to the rule, it generally appears that when there has been an increase in the use of mining machines, there has been also an increase both for the year and for the day in the average production per employee. The following table has been prepared for the purpose of making some comparisons in this particular. Taking some of the more important States, for example: In Illinois the percentage of the machine-mined product to the total increased from 33.66 in 1904 to 35.37 in 1905, and the average production per man per day advanced from 3.13 tons to 3.29 tons; Kentucky's machine percentage increased from 47.52 to 51.44 and the daily production per man from 2.70 to 2.87 tons. Ohio's increases were from 57.31 to 66.39 and from 3.20 to 3.36, and West Virginia's from 29.22 to 33.09 and from 3.49 to 3.74. Striking exceptions, however, are shown in Alabama and Pennsylvania. In the former the percentage of machine coal to the total increased from 6.58 to 13.36 and the production per man declined from 2.93 tons to 2.69 tons, while in the latter the machine percentage increased from 35.91 to 41.66 and the tonnage per man decreased from 3.7 to 3.57.

Average production per man compared with production by machines in 1904 and 1905, 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.	
	1904.	1905.	1904.	1905.	1904.	1905.	1904.	1905.
Alabama	632.3	605.6	2.93	2.69	741,170	1,584,942	6.58	13.36
Arkansas	438.7	461.5	2.66	2.60	....	....	......	......
Colorado	819.7	800.9	3.14	3.14	945,965	1,247,687	14.21	14.14
Illinois	667.0	662.1	3.13	3.29	7,110,902	8,697,547	19.50	22.63
Indiana	553.5	469.7	3.13	3.11	3,613,532	4,207,246	33.66	35.37
Indian Territory	359.9	379.2	1.80	2.02	42,594	40,203	1.40	1.37
Iowa	417.2	449.9	1.96	2.15	175,742	186,224	2.70	2.74
Kansas	519.2	538.7	2.44	2.54	10,600	19,101	.17	.30
Kentucky	532.2	574.2	2.70	2.87	3,595,513	4,409,054	47.52	51.44
Maryland	848.8	858.9	3.76	3.41	484,373	468,822	10.06	9.18
Michigan	378.4	398.6	2.07	2.14	310,007	432,266	23.09	29.34
Missouri	411.2	444.5	2.00	2.29	376,505	375,194	9.03	9.42
Montana	542.5	753.7	2.23	3.10	482,924	752,665	35.54	45.79
New Mexico	785.5	782.7	3.45	3.34	100,000	....	6.89	......
North Dakota	490.8	507.3	2.56	2.71	125,097	97,789	47.01	30.80
Ohio	559.2	588.0	3.20	3.36	13,938,647	16,888,417	57.31	66.10
Pennsylvania:								
Anthracite	469.4	469.5	2.35	2.18	....	....	......	......
Bituminous	724.9	824.4	3.70	3.57	35,174,613	49,335,660	35.91	41.66
Tennessee	459.1	488.9	2.12	2.20	440,618	479,471	9.21	8.04
Texas	409.4	399.2	1.86	1.68	33,154	22,400	2.77	1.86
Utah	1,086.6	979.0	3.70	3.96	34,054	....	2.28	......
Virginia	660.4	746.1	2.77	3.10	245,536	399,029	6.85	9.33
Washington	593.5	601.2	2.44	2.65	....	....	......	......
West Virginia	686.1	781.0	3.48	3.74	9,526,749	12,504,301	29.22	33.09
Wyoming	914.9	937.3	3.49	3.97	1,053,702	1,236,750	20.35	22.08

COAL-MINING ACCIDENTS.

Any statement regarding the coal-mining accidents which attempts to cover the entire United States must necessarily be somewhat incomplete. Statistics of this character are not collected by the Geological Survey, and the information relating thereto contained in this report has been obtained through the courtesy of State or Territory mine inspectors, or other officials by whom data concerning accidents and their causes and effects are compiled. In a number of States where coal is produced there are no officials charged with these duties, and in one or two instances no replies have been received to the inquiries from this Office.

In the following table is presented a statement showing the number of fatal and nonfatal accidents occurring in the coal mines of the United States in 1905, so far as it has been possible to obtain statistics of this kind. This table also shows the number of wives made widows and children left fatherless, when such statistics are collected; the death rate per thousand employees, and the number of tons of coal mined for each life lost. The statement covers 16 of the 31 States and Territories in which coal was produced. These 16 States and Territories included, however, nearly all of the more important coal producers, their aggregate tonnage representing 91.6 per cent of the total output of the United States last year.

In some cases the statistics of accidents are for fiscal years. When this is the case and the other statistics for the same fiscal year are available, the death rate per thousand and the production for each life lost have been figured from the fiscal year and not from the tonnage and labor statistics reported to the Geological Survey for the calendar year. The accident statistics for Arkansas are for the fiscal year ending June 30, 1906, while the tonnage and other figures are for the calendar year 1905. All of these statistics for Illinois, Iowa, New Mexico, and West Virginia are for the fiscal year ending June 30, 1905. The accident statistics for Wyoming are for the fiscal year ending September 30, 1905, and those for Maryland are for the fiscal year ending May 31, 1906, while for both of these States the Geological Survey statistics of production, etc., in 1905 are used.

For the information contained in this table and for more specific notes on some of the more serious accidents acknowledgments are due to the following officials: Mr. J. M. Gray, chief mine inspector, Alabama; Mr. Martin Rafter, State inspector of mines, Arkansas; Mr. John D. Jones, State inspector of coal mines, Colorado; Mr. David Ross, secretary of the bureau of labor statistics, Illinois; Mr. James Epperson, State inspector of mines, Indiana; Mr. William Cameron, United States mine inspector, Indian Territory; Mr. L. E. Stamm, secretary, office of inspector of mines, Iowa; Mr. C. J. Norwood, chief inspector of mines, Kentucky; Mr. Thomas Murphy, State mine inspector, Maryland; Mr. M. J. McLeod, commissioner of labor, Michigan; Mr. J. E. Sheridan, United States mine inspector, New Mexico; Mr. W. H. Werker, chief clerk, department of mines, Ohio; Mr. James E. Roderick, chief of the department of mines, Pennsylvania; Mr. Gomer Thomas, State coal mine inspector, Utah; Mr. D. C. Botting, State inspector of coal mines, Washington; Mr. James W. Paul, chief mine inspector, West Virginia; and Messrs. A. E. Bradbury and Noah Young, State mine inspectors, Wyoming.

In the 17 States and Territories included in the following table the total number of men killed was 2,133 and the total number injured was 4,402. The death rate per thousand was 3.60, and the number of tons mined for each life lost was 175,809. The State which leads in this unfortunate particular is Alabama, which shows a death rate of 9.44 per thousand and a record of only 64,141 tons mined for each life lost. The cause of this showing is discussed more fully later on. Colorado ranks second in the death rate per thousand with 5.35, Indian Territory third with 5.19, Utah fourth with 5.14, and West Virginia fifth with 4.24. Indian Territory came next to Alabama in the small amount of coal mined to each life lost, while third place was occupied by Pennsylvania anthracite.

The best record for the year so far as the death rate is concerned was made by Iowa, where the loss of life per thousand was 1.36. Indiana came second with 1.86, Arkansas third with 1.91, Kentucky fourth with 2, and Wyoming fifth with 2.01. The largest number of tons mined for each life lost was in Wyoming, which produced 466,835 tons for each fatality. Maryland came second, followed in turn by New Mexico, Iowa, and Indiana.

Fatal and nonfatal accidents in coal mines of the United States in 1905.

State.	Number of men killed.	Number of men injured.	Death rate per 1,000 employees.	Number of tons mined for each life lost.	Number of wives made widows.	Number of children left fatherless.
Alabama	185	(a)	9.44	64,141	(a)	(a)
Arkansas	8	34	1.91	241,834	5	14
Colorado	59	120	5.35	149,600	(a)	(a)
Illinois	199	535	3.47	191,156	102	231
Indiana	47	204	1.86	253,090	27	60
Indian Territory	40	59	5.19	73,111	27	63
Iowa	24	100	1.36	283,584	(a)	(a)
Kansas[a]						
Kentucky	36	(a)	2	272,017	14	22
Maryland	13	59	2.19	392,964	10	26
Michigan	8	35	2.16	184,151	(a)	(a)
Missouri[a]						
Montana[a]						
New Mexico	5	(a)	2.35	306,860	(a)	(a)
Ohio	131	543	3.03	194,189	(a)	(a)
Pennsylvania:						
Anthracite	644	1,289	3.89	120,590	349	876
Bituminous	479	1,076	3.33	247,210	255	543
Tennessee	29	(a)	2.38	205,634	13	30
Utah	7	(a)	5.14	190,339	3	13
Washington	13	90	2.73	220,379	7	17
West Virginia	194	250	4.24	181,873	83	169
Wyoming	12	8	2.01	466,835	12	23
Total	2,133	4,402	3.60	175,809	907	2,087

[a] Not reported.

For purposes of comparison with the fatalities in the coal-mining accidents of 1904 the following table, taken from a compilation made by Mr. Fred. L. Hoffman and published in the Engineering and Mining Journal of December 2, 1905, is given:

State.	Persons killed, yearly average.	Rate per 1,000 employed.
Alabama	84	4.71
Colorado	89	8.26
Illinois	157	2.87
Indiana	34	2.70
Indian Territory	30	3.63
Iowa	31	1.90
Kansas	[a]32	3.09
Kentucky	19	1.37
Maryland	(b)	(b)
Missouri	11	1.47
New Mexico	15	7.61
Ohio	118	2.57
Pennsylvania (anthracite)	595	3.69
Pennsylvania (bituminous)	536	3.45
Tennessee	28	2.81
Utah	9	4.06
Washington	31	6.69
West Virginia	140	3.08
Total	1,959	3.46

[a] For Kansas the returns for 1904 are estimated for the last half of the year.
[b] Returns not available for 1904.

Among the more serious accidents which occurred in 1905, or in the fiscal years included in the preceding table, may be mentioned the following, taking the States in alphabetical order:

Alabama.—The large death rate in Alabama was due to an explosion which occurred in the Virginia mine of the Southern Steel Company on February 20, 1905. As a result of this explosion 112 men were killed. A commission appointed to investigate the disaster reported that it was a dust explosion caused by a "windy" or "blown-out" shot.

Illinois.—The most serious accident that occurred in Illinois during last year was an explosion of gas on April 3, at the Zeigler mine in Franklin County, by which 50 men lost their lives. On December 9, 1904, 4 men were killed by a blown-out shot. Mr. David Ross, secretary of the bureau of labor statistics, states that most of the fatalities in Illinois are due to premature blasts or windy shots. There have been few explosions of gas, the accident at Zeigler being the only one in 5 years which resulted in the death of more than 5 persons.

Indiana.—On March 10, 1905, an explosion caused by a misplaced shot in the Oswald mine of the Princeton Coal and Mining Company, at Gibson, resulted in the death of 10 men, 5 of whom were killed instantly. All of the other fatal accidents were single, and most of them were due to falls of slate.

Indian Territory.—An explosion from unknown cause which occurred at the mine of the Missouri, Kansas and Texas Coal Company on April 30 was responsible for the death of 13 persons. There were 5 other instances, in each of which 2 men were killed. One of these was an explosion of gas, 1 a powder explosion, 1 was a premature blast, and 2 were windy shots.

Pennsylvania.—In the anthracite region of Pennsylvania there were 4 accidents which resulted in the death of more than 1 person. They were as follows:

On February 18, in the twelfth inspection district, at the Lytle colliery of the Susquehanna Coal Company, in Schuylkill County, 5 persons were killed by a fall of rock.

On March 9, in the sixth inspection district, at the Clearspring colliery of the Clearspring Coal Company, in Luzerne County, 7 persons were killed by the falling of the cage.

On April 26, in the seventh district, 10 persons were killed by the falling of the cage at the Conyngham shaft of the Delaware and Hudson Company, in Luzerne County. In this case the rope broke and the safety catches failed to work.

On December 13, in the fourteenth inspection district, at the Luke Fidler colliery of the Mineral Railroad and Mining Company, in Northumberland County, an explosion of fire damp resulted in the death of 3 persons.

In the bituminous districts there were 9 accidents in which more than 1 person was killed. These were as follows:

On March 17, at the Sykes shaft of the Jefferson and Clearfield Coal and Iron Company, in Jefferson County, 2 persons were killed by an explosion of dynamite.

On April 27, at the Eleanora shaft of the Rochester and Pittsburg Coal and Iron Company, also in Jefferson County, 12 persons were killed by an explosion of gas and dust.

On July 6, at the Fuller mine of the Taylor Coke Company, in Fayette County, 6 persons were killed by an explosion of gas, and on November 13, in the same mine, another explosion occurred that resulted in the death of 3 persons.

On October 10, at the Hazel Kirk mine of the Schoenberger Gas Coal Company, in Washington County, 2 miners were suffocated by after damp, and on October 29, in the same mine, 5 persons were killed by an explosion of fire damp.

On October 13, at the Clyde mine of the Clyde Coal Company, in Washington County, 6 persons were suffocated by after damp.

On November 15, in the Braznell mine of the Braznell Gas Coal Company, in Washington County, an explosion of fire damp killed 7 miners.

On December 28, at the Kantner mine of the Shade Smokeless Coal Company, in Somerset County, an explosion of dynamite resulted in the death of 3 persons.

It will be seen from the foregoing that out of these 13 accidents which were attended with fatal results to more than 1 person in each case, 6 were due to explosions of gas, or of gas and dust mixed, 2 were due to the falling of cages, 2 to suffocation by after damp, 1 to a fall of rock, and 2 to explosions of dynamite.

In 8 out of these 13 accidents the fault was placed either upon the victims themselves or upon fellow-employees. Two were classed as unavoidable, and in 2 cases the responsibility was not fixed. In the accident at the Conyngham shaft the rope broke and the safety catches failed to work.

West Virginia.—There were 3 accidents which resulted in the death of more than 2 persons each inside the mines in West Virginia during the fiscal year ending June 30, 1905. The first of these occurred on February 26, and was an explosion of powder, dust, and dynamite at the Grapevine shaft of the United States Coal and Coke Company, in McDowell County. Seven deaths resulted from this explosion.

On March 18 and 19 two explosions of dust at the Rush Run and Red Ash mines of the New River Smokeless Coal Company, in Fayette County, resulted in the death of 24 men.

On April 20, at the Cabin Creek mine of the Cabin Creek Mining Company, in Kanawha County, an explosion of powder killed 6 men.

There were 3 accidents, in each of which 2 men were killed, all of these being due to falls of roof. One was at the Tug River mine of the Pocahontas Coal Mining Company, in McDowell County; 1 at the Keystone mine of the Keystone Coal and Coke Company, in McDowell County, and 1 at the War Eagle mine of the War Eagle Coal Company, in Mingo County.

On March 7, 1905, some runaway cars on the incline of No. 101 mine of the Kanawha and Hocking Coal and Coke Company killed 4 men. This accident was outside the mine. In addition to the 4 men killed by these runaway cars 4 other men were seriously injured.

PRICES.

The following tables show the fluctuations in the average prices prevailing in each State since 1901, 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 prices for both anthracite and bituminous coal in 1903 were the highest in any year since 1881, inclusive. With only a few exceptions prices have declined generally throughout the United States during the last two years.

Average prices for coal at the mines since 1900.

[Per short ton.]

State or Territory.	1901.	1902.	1903.	1904.	1905.
Alabama	$1.10	$1.20	$1.22	$1.20	$1.21
Arkansas	1.14	1.31	1.51	1.54	1.49
California	[a]2.65	[a]3.14	[a]2.86	[a]4.74	[a]4.97
Colorado	1.13	1.13	1.23	1.31	1.22
Georgia	1.20	[b]1.42	[b]1.26	[b]1.22	[b]1.29
Idaho	....	[c]2.50	3.10	[c]3.95	[c]3.03
Illinois	1.03	1.03	1.17	1.10	1.06
Indiana	1.01	1.10	1.23	1.11	1.05
Indian Territory	1.62	1.51	1.82	1.82	1.76
Iowa	1.39	1.47	1.65	1.61	1.56
Kansas	1.22	1.30	1.52	1.52	1.46
Kentucky	.95	.99	1.06	1.04	.99
Maryland	.99	1.06	1.48	1.19	1.14
Michigan	1.41	1.71	1.97	1.81	1.71
Missouri	1.24	1.38	1.61	1.63	1.58
Montana	1.44	1.65	1.64	1.61	1.72
New Mexico	1.42	1.43	1.37	1.31	1.33
North Carolina	1.25	([d])	([d])	([d])	([d])
North Dakota	1.29	1.44	1.50	1.43	1.34
Ohio	1.00	1.14	1.29	1.09	1.04
Oregon	2.52	2.44	2.43	2.18	2.58
Pennsylvania bituminous	.99	1.08	1.18	.96	.96
Tennessee	1.12	1.23	1.25	1.18	1.14
Texas	1.72	1.64	1.62	1.66	1.64
Utah	1.26	1.14	1.20	1.30	1.35
Virginia	.86	.80	.96	.86	.88
Washington	1.66	1.72	1.69	1.63	1.79
West Virginia	.87	1.01	1.17	.88	.86
Wyoming	1.35	1.18	1.24	1.30	1.31
Total bituminous	1.04	1.12	1.24	1.10	1.06
Pennsylvania anthracite	1.67	1.84	2.04	1.90	1.83
General average	1.19	1.22	1.41	1.26	1.21

[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 26 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	1905	1.83	1.06

CONSOLIDATIONS IN 1905.

The scenes of the principal consolidations of corporations engaged in the coal-mining industry in 1905 were in Illinois and Indiana, although a number of important mergings were reported also from Ohio and West Virginia.

The consolidations effected in the different States were as follows:

Illinois.—The O'Gara Coal Company, of Chicago, Ill., was organized in 1905 for the purpose of taking over nearly all of the mines in Saline County. The companies that were merged into the O'Gara Coal Company were the Carriers Mills Coal Company, the Eldorado Coal Company, the Clifton Coal Company, the Diamond Coal Company, the Egyptian Coal and Coke Company, the Gas Coal Company, the Harrisburg Mining and Coal Company, the Ledford Coal Company, the Morris Coal Company, the New Coal Company, and the Davenport Coal Company, nearly all of these properties being in the vicinity of Harrisburg, Ill. The O'Gara Coal Company took over also the Jefferson Coal Mining Company, in Sangamon County.

The Southern Coal and Mining Company, of St. Louis, Mo., was formed by the consolidation of the Germantown Coal and Mining Company, the Muren Coal and Ice Company, the Oak Hill Coal Company, the Dutch Hollow Coal Company, the Glendale Coal and Mining Company, the Tower Grove Coal Company, the Dutch Hill Coal Company, and the Walnut Hill Coal Company, most of the mines thus taken over being located in St. Clair County, Illinois.

The Peabody Coal Company, of Chicago, took over the Nokomis Coal Company, of Macon County, and the Southern Illinois Coal Mining and Washing Company, of Williamson County.

Indiana.—There were 5 important consolidations of coal-mining interests in Indiana during 1905, the principal one of which probably being the formation of the Vandalia Coal Company, with headquarters in Indianapolis. This company took over the following properties:

The Cloverland Coal and Mining Company, in Clay County; the Asherville Mining Company, in Clay County; the Island Valley Coal and Mining Company, in Clay and Greene counties; the Enterprise Coal Company, in Knox County; the Indiana Bituminous Coal Company, in Clay County; the Island Coal Company, in Greene and Sullivan counties; the Johnson Coal Mining Company, in Greene County; the South Linton Coal Company, in Greene County; the Minshall Vein Coal and Mining Company, in Parke County; the Raccoon Valley Mining Company, in Parke County; Zeller, McClelland & Co., in Clay and Parke counties; the Indiana and Chicago Coal Company, in Sullivan County, and the Greenfield Coal and Mining Company, the Home Coal Company, the Lost Creek Coal Company, the Seelyville Coal Mining Company, the Sugar Creek Coal Company, and the Loughner Coal Mining Company, in Vigo County.

The Dering Coal Company, an Illinois concern which had been operating in Franklin, Montgomery, and Vermilion counties, in that State, purchased in 1905 the following properties in Indiana:

The J. Wooley Coal Company, Bruiletts Creek Coal Company, the Wilfred Coal Company, the Indiana Fuel Company, the W. S. Bogle Coal and Mining Company, and the Willow Grove Coal Company, the mines of these different concerns being located in Sullivan, Vermilion, and Vigo counties.

The Consolidated Indiana Coal Company, with headquarters in the Old Colony Building, Chicago, merged the properties of the North Jackson Hill Coal Mining Company, the Sullivan County Coal Company, the Union Coal Company, the Harder & Hafer Coal Mining Company, the Hymera Coal Mining Company, and the Keller Coal Company, all of the mines but one thus changing ownership being located in Sullivan County. This one exception is in Vermilion County.

The Indiana Southern Coal Company, also in the Old Colony Building, Chicago, took over the Indiana Hocking Coal Company, the Citizens Coal Company, the Cummings Coal Company, the Rainbow Coal Mining Company, the New Pittsburg Coal and Coke Company, and the Green Hill Coal and Mining Company, in Sullivan County, and the Forest Coal Company, in Vigo County.

The Southern Indiana Coal Company, of the Old Colony Building, Chicago, took over the Hoosier Coal Company, the Midland Coal Company, the Tower Hill Coal Company, the Lattas Creek Coal Company, all in Greene County, and the Linton Semi-Block Coal Company, in Sullivan County.

The United Fourth Vein Coal Company, of Linton, Ind., has taken over the properties of the Island Valley Coal and Mining Company, in Clay and Greene counties, and those of the Antioch Coal Company, L. T. Dickerson, the Black Creek Semi-Block Coal Company, and the North Linton Coal Company, all in Greene County.

Ohio and West Virginia.—During 1905 the Continental Coal Company, which had itself been formed by the consolidation of a number of properties in Athens, Hocking, and Perry counties, was merged into the Sunday Creek Company, of Columbus, Ohio, which took over also the Buckeye Coal and Railway Company, in Hocking and Perry counties, Ohio, and the Kanawha and Hocking Coal and Coke Company, in Fayette and Kanawha counties, W. Va.

Other States and Territories.—In Alabama the Pratt Consolidated Coal Company, of Jefferson County, took over the properties of the Ivy Coal and Iron Company, in Walker County. In Kentucky the West Kentucky Coal Company, of Sturgis, took over the Tidewater Coal Company, the United States Gas, Coal and Coke Company, in Union County, and the Caney Fork Coal and Mining Company, the Rock Spring Coal and Coke Company, and the Wheatcroft Coal and Mining Company, in Webster County. In Indian Territory the Degnan and McConnell Coal and Mining Company succeeded to the properties of the Eastern Coal and Mining Company, the McAlester Coal and Mining Company, the Missouri, Kansas and Texas Coal Company, and the Mexican Gulf Coal and Transportation Company.

SHIPMENTS BY RAILROADS.

From the reports received from producers the following tables, showing the amount of bituminous coal loaded for shipment by different railroads, has been compiled. This statement does not represent the total coal carried by the various lines, but is prepared from the replies to the inquiry as to the name of the railway over which the production from each mine was shipped. In quite a large number of cases where the mines were located on two or more lines of railroads, the shipments reported have been equally divided. In some other instances, operators (usually small ones) did not reply to the inquiries, and the table is therefore incomplete to the extent represented by these two factors. It gives, however, an approximate idea of the amount of coal originating on the different lines.

The first table shows the tonnage originating on the lines of the great interstate systems. The second table exhibits the tonnage loaded on the larger lines penetrating, with a few exceptions, two or three States only, while the third table shows the shipments over less important lines, but whose tonnage exceeded 100,000 in 1905.

The shipments represented by these tables amounted to about 226,000,000 tons, whereas the total quantity of bituminous coal loaded for shipment during 1905 amounted to a little over 255,000,000 tons.

It appears from these tables that something over 49,000,000 tons, or over 20 per cent of the total, originated on the Pennsylvania system, which includes the Pennsylvania Railroad, the Pennsylvania Company, the Pennsylvania lines west of Pittsburg, the Terre Haute and Indianapolis, and the Vandalia railroads. Second in importance is the Baltimore and Ohio (including the Baltimore and Ohio Southwestern) with total shipments slightly in excess of 20,000,000 tons, or about 9 per cent of the total. The Frisco system, which includes also the Chicago and Eastern Illinois, shipped something over 10,000,000 tons, followed closely by the Norfolk and Western with nearly 10,000,000 tons, the Illinois Central with over 9,000,000 tons, and the Chesapeake and Ohio with over 8,900,000 tons.

The shipments over the larger systems and lines in the United States were distributed as follows:

Shipments of bituminous coals over the principal railroad lines and systems of the United States.

State.	Pennsylvania.[a]	Baltimore and Ohio.[b]	Frisco.[c]	Norfolk and Western.	Illinois Central.	Chesapeake and Ohio.	Louisville and Nashville.	Southern.
Pennsylvania	37,069,828	5,298,274			6,615,369			
Illinois	875,995	881,893	3,420,428				458,256	790,728
West Virginia	233,745	7,994,392		8,739,077		8,792,671		
Ohio	5,091,700	5,652,397						
Alabama			1,567,049		65,696		3,125,792	2,454,732
Indiana	2,463,853	26,273	2,868,176		488,206			638,657
Kentucky				101,432	2,253,289	142,169	3,814,623	231,038
Colorado								
Iowa					7,195			
Kansas			2,286,631					
Wyoming								
Maryland	3,446,722	445,603						
Tennessee							632,269	2,312,761
Missouri			104,681					
Virginia				983,483			148,099	317,258
Washington								
Indian Territory			51,038					
Arkansas			86,455					
Total	49,181,843	20,298,832	10,384,458	9,823,992	9,429,755	8,934,840	8,179,039	6,745,174

[a] Includes the Pennsylvania Company, Pennsylvania lines west of Pittsburg, Terre Haute and Indianapolis, Vandalia, and other subsidiary companies.
[b] Includes the Baltimore and Ohio Southwestern.
[c] Includes the Chicago and Eastern Illinois.

Shipments of bituminous coals over the principal railroad lines and systems of the United States—Continued.

State.	Burlington.[a]	Wabash.[b]	Santa Fe.	Hocking Valley.	Missouri Pacific.[c]	Pittsburg and Lake Erie.	Rock Island.[d]	Chicago and Northwestern.	Big Four.
Pennsylvania		118,584				3,160,319			
Illinois	2,756,229	2,812,260	494,508		922,566		686,956	1,280,874	1,923,031
West Virginia		1,533,706				49,294			
Ohio		140,050		4,362,250		5,044			43,959
Alabama									
Indiana				875					410,649
Kentucky									
Colorado	151,564		557,867				15,865		
Iowa	1,208,015	228,762					779,824	1,437,250	
Kansas	22,649		2,340,929		928,956		22,648		
Wyoming	1,081,990							54,744	
Maryland		347,509							
Tennessee									
Missouri	384,787	267,600	188,758		835,592		67,498		
Virginia									
Washington									
Indian Territory			2,083				1,155,843		
Arkansas					1,006,742		76,142		
Utah									
New Mexico			976,785						
Montana									
Michigan									
Texas							40,850		
Total	5,605,234	5,448,471	4,560,930	4,363,125	3,693,856	3,214,657	2,845,626	2,772,868	2,377,639

[a] Includes the Chicago, Burlington and Quincy, Burlington and Missouri River, Burlington and Western, Kansas City and Omaha, and other subsidiary lines.
[b] Includes the Wabash Pittsburg Terminal, Wheeling and Lake Erie, and West Virginia Central and Pittsburg.
[c] Includes the St. Louis, Iron Mountain and Southern.
[d] Includes the Choctaw, Oklahoma and Gulf.

Shipments of bituminous coals over the principal railroads of the United States.

Railroad.	State.	Quantity, short tons.	Total.
New York Central and Hudson River	Pennsylvania	6,307,762	6,307,762
Buffalo, Rochester and Pittsburg	do	6,291,806	6,291,806
Union Pacific	Colorado	61,282	4,345,174
	Kansas	66,757	
	Wyoming	4,166,852	
	Utah	50,283	
Denver and Rio Grande	Colorado	1,819,233	2,808,242
	Utah	959,009	
	New Mexico	30,000	
Chicago and Alton	Illinois	2,455,409	2,663,085
	Missouri	207,676	
Northern Pacific	Washington	1,936,684	2,648,395
	Montana	666,066	
	North Dakota	45,645	
Colorado and Southern	Colorado	2,289,271	2,289,271
Wheeling and Lake Erie	West Virginia	4,022	2,260,841
	Ohio	2,256,819	
Missouri, Kansas and Texas	Kansas	774,131	2,153,344
	Missouri	103,535	
	Indian Territory	1,193,936	
	Texas	81,742	
Kanawha and Michigan	West Virginia	1,790,254	1,875,521
	Ohio	85,267	
Toledo and Ohio Central	do	1,728,774	1,728,774
Bessemer and Lake Erie	Pennsylvania	1,584,619	1,584,619
Erie	Pennsylvania	1,247,909	1,494,743
	Ohio	246,834	
Cincinnati, Hamilton and Dayton	Illinois	169,754	1,491,340
	Ohio	538,171	
	Indiana	15,328	
	Michigan	768,087	
Evansville and Terra Haute	Indiana	1,415,236	1,415,236
Nashville, Chattanooga and St. Louis	Alabama	14,672	1,087,791
	Tennessee	1,064,537	
	Georgia	8,582	
Missouri and Louisiana	Missouri	529,332	944,778
	Arkansas	415,446	
Chicago, Milwaukee and St. Paul	Illinois	61,461	881,338
	Iowa	819,877	
Iowa Central	Illinois	383,221	839,040
	Iowa	455,819	
Great Northern	Montana	793,665	832,233
	North Dakota	38,568	
Mobile and Ohio	Illinois	628,692	819,441
	Alabama	190,749	
Cincinnati, New Orleans and Texas Pacific	Kentucky	273,345	690,260
	Tennessee	416,915	
Kansas City Southern	Kansas	332,641	433,401
	Missouri	17,140	
	Indian Territory	83,620	
Midland Valley	Indian Territory	39,399	219,317
	Arkansas	179,918	

The shipments over the railroads which penetrate only one or two States, and which were less than 1,000,000 tons and over 100,000 tons in 1905, have been reported as follows:

Railroad.	State.	Amount.
		Short tons.
Alabama Great Southern	Alabama	111,090
Beech Creek	Pennsylvania	873,095
Buffalo and Susquehanna	.....do	438,116
Central of Georgia	Georgia	164,113
Central Indiana	Indiana	161,819
Chicago Great Western	Iowa and Kansas	233,303
Chicago and Illinois Midland	Illinois	226,396
Chicago, Indianapolis and Louisville	Indiana	224,589
Chicago, Peoria and St. Louis Railway of Illinois	Illinois	603,107
Coal and Coke	West Virginia	248,027
Colorado Midland	Colorado	282,706
Colorado and Southeastern	.....do	704,556
Colorado and Wyoming	.....do	100,921
Columbia and Puget Sound	Washington	654,693
Denver, Northwestern and Pacific	Colorado	178,339
Des Moines, Iowa Falls and Northern	Iowa	123,694
Detroit, Toledo and Ironton	Ohio	759,277
East Broad Top	Pennsylvania	143,952
Elgin, Joliet and Eastern	Illinois	964,430
El Paso and Northeastern	New Mexico	413,594
Evansville and Indianapolis	Indiana	157,172
Fort Smith and Western	Indian Territory	250,311
Georges Creek and Cumberland	Maryland	230,269
Harriman and Northeastern	Tennessee	308,315
Huntingdon and Broad Top Mountain	Pennsylvania	475,809
Illinois Southern	Illinois	173,045
Indiana, Illinois and Iowa	.....do	215,523
International and Great Northern	Texas	148,193
Iowa and St. Louis	Missouri	256,184
Kellys Creek	West Virginia	129,426
Lake Erie, Alliance and Wheeling	Ohio	971,065
Lake Shore and Michigan Southern	Pennsylvania and Ohio	157,225
Lick Creek and Lake Erie	Virginia	440,185
Litchfield and Madison	Illinois	812,165
Louisville, Henderson and St. Louis	Kentucky	101,262
Michigan Central	Michigan	426,334
Minneapolis, St. Paul and Sault Ste. Marie	North Dakota	110,428
Monongahela	Pennsylvania	351,719
New Haven and Dunbar	.....do	236,863
Newton and Northwestern	Iowa	214,702
Peoria and Pekin Union	Illinois	217,055
Pittsburg and Castle Shannon	Pennsylvania	101,267
Pittsburg, Shawmut and Northern	.....do	687,415
Quincy, Omaha and Kansas City	Missouri	288,053
St. Louis and Belleville	Illinois	299,723
St. Louis and O'Fallon	.....do	408,300
St. Louis, Troy and Eastern	Illinois	956,468
Seaboard Air Line	Alabama	177,436
Texas and Pacific	Texas	573,656
Toledo, Peoria and Western	Illinois	189,199
Toledo, St. Louis and Western	.....do	304,982

Railroad.	State.	Amount.
		Short tons.
Toluca, Marquette and Northern	Illinois	173,753
Virginia and Southwestern	Virginia	333,588
Western Allegheny	Pennsylvania	564,154
Zanesville and Western	Ohio	738,938

It must be remembered that the foregoing statement refers to bituminous coal only. Mr. William W. Ruley, who prepared that portion of this report which covers the production of anthracite coal in Pennsylvania, is the authority for the statement that the shipments of anthracite by the principal railroads penetrating that region in 1905 were as follows:

Shipments of Pennsylvania anthracite in 1905.

	Long tons.
Philadelphia and Reading[a]	20,557,776
Lehigh Valley (including Delaware, Susquehanna and Schuylkill)	11,677,498
Lackawanna	9,554,046
Erie	6,225,622
Delaware and Hudson	5,640,528
Pennsylvania	4,890,635
New York, Ontario and Western	2,864,095

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 1900 to 1905, 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.

[a] Including Central Railroad of New Jersey and Lehigh Coal and Navigation Company.

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 1905 were 9,189,248 long tons, valued at $28,972,618, of which 2,229,983 long tons, valued at $11,104,654, were anthracite, and 6,959,265 long tons, valued at $17,867,964, were bituminous coal. The imports of anthracite amounted in 1905 to 34,241 long tons, valued at $107,314, and those of bituminous coal to 1,611,002 long tons, valued at $3,903,765. From this it can be seen that the imports of anthracite coal into the United States are relatively of 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 quantity 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, 1900–1905.

Year.	Anthracite.		Bituminous and shale.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
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
1905	34,241	107,314	[b] 1,611,002	3,903,765

[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, 579,204 tons imported in 1904, and 611,053 tons imported in 1905.

Coal of domestic production exported from the United States, 1900–1905.

Year.	Anthracite.		Bituminous and shale.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
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
1905	2,229,983	11,104,654	6,959,265	17,867,964

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 (1905)	long tons	350,820,840	392,919,341
Great Britain (1905)	do	236,128,936	264,464,408
Germany (1905)	metric tons	173,796,674	191,576,074
Austria-Hungary (1904)	do	41,014,182	45,209,933
France (1904)	do	34,167,966	37,663,349
Belgium (1905)	do	21,844,200	24,078,862
Russia and Finland (1904)	do	19,318,370	21,294,639
Japan (1903)	do	10,088,845	11,120,934
Canada (1905)	short tons	8,775,933	8,775,933
India (1904)	long tons	8,216,706	9,202,711
New South Wales (1904)	do	6,019,809	6,742,186
Spain (1905)	metric tons	3,202,911	3,530,569
South African Republic (1904)	long tons	2,409,033	2,698,117
New Zealand (1904)	do	1,537,838	1,722,379
Mexico (1904)	metric tons	700,000	771,610
Sweden (1904)	do	320,984	353,821
Italy (1904)	do	362,151	399,199
Holland (1904)	do	466,997	514,771
Queensland (1904)	long tons	512,015	573,457
Victoria (1904)	do	121,741	136,350
Natal (1904)	do	858,298	961,294
Cape Colony (1904)	do	154,272	172,785
Tasmania (1904)	do	61,109	68,442
Other countries [a]	do	7,298,935	8,174,807
Total			1,033,125,971
Percentage of the United States			38

[a] Includes China, Turkey, Servia, Portugal, United States of Colombia, Chile, Borneo and Labuan, Peru, Greece, etc.

The growth of the coal-mining industry in the United States compared with that of the other countries of the world since 1868 is shown in the following table. From this it appears that during this period of 38 years the percentage of the world's total produced by the United States has increased from 14.32 to 38, and this country now stands far in the lead of the world's coal producers. It has been only 7 years since the United States supplanted Great Britain as the leading coal-producing country, and yet in that time the increase in this country has been so enormous that Great Britain can no longer be classed as a competitor. The production of the United States in 1905 was nearly 50 per cent larger than that of Great Britain, more than double that of Germany, and nearly two and one-fourth times that of all other countries, outside of Great Britain and Germany, combined.

World's production of coal, by countries, 1868–1905.

Year.	United States.		Great Britain.		Germany.	
	Long tons.	Short tons.	Long tons.	Short tons.	Metric tons.	Short tons.
1868	29,341,036	32,861,960	103,141,157	115,518,096	32,879,123	36,249,233
1869	29,378,893	32,904,360	107,427,557	120,318,864	34,343,913	37,864,164
1870	29,496,054	33,035,580	110,431,192	123,682,935	34,003,004	37,488,312
1871	41,861,679	46,885,080	117,352,028	131,434,271	37,856,110	41,736,361
1872	45,940,535	51,453,399	123,497,316	138,316,994	42,324,467	46,662,725
1873	51,430,786	57,602,480	128,680,131	144,121,747	46,145,194	50,875,076
1874	46,969,571	52,605,920	126,590,108	141,780,921	46,658,145	51,440,605
1875	46,739,571	52,348,320	133,306,485	149,303,263	47,804,054	52,703,970
1876	47,571,429	53,280,000	134,125,166	150,220,186	49,550,461	54,629,383
1877	54,019,429	60,501,760	134,179,968	150,281,564	48,229,882	53,173,445
1878	51,728,214	57,935,600	132,612,063	148,525,511	50,519,899	55,698,188
1879	60,808,749	68,105,799	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	314,121,784	351,816,398	232,428,272	260,319,665	169,450,583	186,785,378
1905	350,820,840	392,919,341	236,128,936	264,464,408	173,796,674	191,576,074

World's production of coal, by countries, 1868–1905—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	41,014,182	45,209,933	34,167,966	37,663,349	22,761,430	25,089,924
1905	....	....	....	....	21,844,200	24,078,862

World's production of coal, by countries, 1868–1905—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	222,248,430	14.79
1869	579,419	638,510			1,104,563	230,444,213	14.28
1870	667,806	735,922			1,063,121	234,850,088	14.07
1871	772,371	851,153			1,114,248	261,061,424	17.96
1872	1,037,611	1,143,447			1,268,115	283,590,322	18.14
1873	1,154,618	1,272,389			1,502,516	303,181,376	19.00
1874	1,270,889	1,400,520			2,708,756	298,676,379	17.61
1875	1,673,753	1,844,475			2,639,104	308,479,177	16.97
1876	1,795,146	1,968,251			2,597,143	311,674,969	17.09
1877	1,760,276	1,939,824			2,821,155	317,198,648	19.07
1878	2,483,575	2,738,141			3,176,050	318,523,990	18.10
1879	2,874,790	3,169,456			3,362,605	335,237,908	20.32
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	37,907,163	888,453,950	33.95
1903	17,818,000	19,640,781	10,088,845	11,120,934	37,562,430	972,195,531	36.76
1904	[a] 19,318,370	21,294,639		(b)	[c] 40,945,965	980,246,185	35.89
1905							

[a] These figures also include the production of Finland.
[b] Latest available figures are used in making up totals for 1904.
[c] This includes the output of Canada (1905, 8,775,933 short tons); India (1904, 9,202,711 short tons); New South Wales (1904, 6,742,186 short tons); Spain (1905, 3,530,569 short tons); South African Republic (1904, 2,698,117 short tons); New Zealand (1904, 1,722,379 tons); Sweden (1904, 353,821 tons); Italy (1904, 399,199 tons); Queensland (1904, 573,457 tons); also that of Holland, Natal, Cape Colony, Tasmania, Mexico, China, Turkey, Servia, Portugal, etc. (estimated), 8,174,807 tons.

COAL TRADE REVIEW.

Outside of the largely increased production, there were no special features which marked the coal trade in 1905, either in anthracite or bituminous circles. In the anthracite trade the principal factor seemed to be the preparation for a possible suspension of mining on March 31, 1906, when the awards of the Anthracite Coal Strike Commission would terminate. This spirit of preparation appeared to affect both sides. Operators were pushing production and placing large quantities of coal in stock at a number of storage plants, and the miners seemed willing to work and to "lay by" for a strike emergency. A large part of this preparation was done in the summer months. Consumers had also been forehanded and their cellars had furnished much of the storage capacity. The fall and early winter months were, however, unusually mild, and the customary immediate demands were not in evidence. As a result, with storage capacity filled, and production unusually large, a glut was threatened, and it was found necessary to shut down the mines several days in each week. Another factor of some interest was the abundance in the markets of the small or steam sizes. During the strike of 1902 many users of small anthracite had been driven to bituminous coal, and continued to use it even after a full supply of buckwheat, rice, and barley coals was obtainable. In addition to this, the production and storage of the domestic sizes was adding to this oversupply of small coal. A decided and general cut in prices for these small sizes was threatened, and some cutting was done by independent interests, but strong influences were exerted and demoralization was prevented. The close of the year found the operators in a strong position for the contest expected to come in April. It is a pleasure to be able to note that while the miners did suspend work for a few weeks, there was no strike officially declared, and after some skirmishing the miners finally agreed to accept the operators' offer to extend the award of the Anthracite Commission for another three years.

Bituminous trade was marked principally by production in excess of market requirements, and this naturally resulted in a depression of values. Prices declined in nearly every one of the important producing States. At times it was stated that coal was sold in some of the western markets at prices which barely paid the charges for freight and demurrage. There was, in spite of this condition, the usual complaint of car shortage, though there is little doubt that had the transportation companies furnished all the cars desired, the glut of coal at consuming points would soon have affected a complete demoralization of the trade. During the anthracite strike of 1902, and immediately subsequent thereto, when prices for bituminous coal were abnormally inflated, many new bituminous mines were opened, and the capacity of old ones was increased, and it is safe to assert that the bituminous coal mines of the United States are capable of producing, if pushed to full capacity, 50 per cent more than the approximately 315,000,000 ton output of 1905.

Aside from this statement in regard to the tendency to overproduction, which even the extraordinary demand in the iron and other manufacturing industries could not entirely overcome, there was nothing of peculiar interest, particularly among the eastern States, in 1905. There were no labor troubles of note, and except for the lower prices, conditions were generally satisfactory. Among the western central States mining and market conditions were somewhat similar to those in the east, except Illinois, where some difficulty was experienced as the result of the enactment of what is known as the "short-firers' law," a piece of legislation highly obnoxious to the operators, and the wisdom of which is certainly open to some question. The matter was finally adjudicated by Judge George Gray, to whom it was referred after a pretty general shut down of the Illinois mines. It is understood that in the wage-scale agreement for 1906 the miners' representatives have promised to use their efforts in securing a repeal.

In the Southwest the competition of fuel oil caused by the greatly increased production of petroleum in Texas had the effect of materially reducing the demand for coal, and the mines of Arkansas and Indian Territory were operated with reduced forces, and production was materially lessened. During the summer months, when trade was particularly bad, many miners sought other fields of employment, and the railroad companies directed their cars to other producing sections. In the fall, when oil production declined and the demand for coal increased, operators could not secure full advantage because of the shortage in labor and cars. Conditions similar to those in the Southwest prevailed on the Pacific coast, where coal production was curtailed by the increased production and use of California petroleum.

The strike ordered in 1904 against the coal and iron companies in Alabama was still officially in effect in 1905, but did not seriously affect production, as new men were engaged to take the places of the strikers and the mines were operated "open shop."

A comprehensive idea of the conditions which prevailed throughout the United States may be obtained from the following reviews of the coal trade in the principal cities. These reviews have been prepared by secretaries of boards of trade or other local authorities familiar with the coal trade conditions.

NEW YORK CITY.

The following review of the coal trade of New York City has been prepared for this report by Mr. Frederick Hobart, associate editor of the Engineering and Mining Journal:

In earlier years Philadelphia was regarded as the main center of the anthracite trade, but that position long ago passed to New York. Tidewater prices are now based on the selling rates at New York Harbor points, and the larger part of the seaboard anthracite supply passes through the shipping ports on the bay of New York and the Hudson River. This movement, which is chiefly to New England points, serves to equalize the trade during the year. The coast ports, especially those beyond Cape Cod, take the greater part of their supply during the summer, when shipments by water can best be made and when the local trade is quiet.

New York City itself is peculiarly a weather market. This arises from local conditions. The local dealers and distributors of coal do not carry large stocks, partly because the value of land is so high that they can not afford large storage yards, partly because new supplies are always to be had readily. Fully 80 per cent of the population of the city live in tenement houses and flats, where they can not keep any coal beyond the limited quantity needed from day to day. Even in the large apartment houses and office buildings, which are heated from central plants, it is not the custom to carry much stock ahead, for the same reason, that space is too valuable. Hence deliveries vary from week to week in a considerable degree.

New York is also a large consumer of the small or steam sizes of anthracite, as well as of the larger domestic sizes. Many manufacturers use those sizes to avoid trouble with local antismoke ordinances. Their use is also common in the hotels, the large office buildings, and apartment houses, both for the necessary steam plants and the central heating plants. Pea coal, indeed, is coming to be more and more in use for domestic purposes. In part this is due to the fact that makers of stoves and ranges are putting on the market grates adapted to the use of this size; in part also to the common, though unacknowledged, practice of retail coal dealers, who frequently mix from 10 to 25 per cent of pea with their chestnut size, selling the whole as chestnut coal.

The local market in 1905 was another proof of the existence of these conditions. The year opened with a heavy demand, due to the very cold weather then prevailing. There was no trouble about supplies at the harbor docks, which were abundant; but there was a good deal of difficulty in deliveries locally. This was due to ice in the rivers, impeding the movement of barges to an extent unusual in New York, to the trouble attending the handling of frozen heaps of coal, and to the bad condition of the streets, owing to snow and ice. The retail dealers complained of the extra cost of deliveries and sought to repay themselves by heavy charges on the small orders. The 80 per cent or more of New Yorkers who buy their coal in quantities from a ton down to a sack or pail at a time, found the cost a greater burden than usual.

As spring came on rather later than usual, it was well on in April before the city trade began to lapse into the usual dullness. The balance of shipment was maintained after that date, however, by the rush of buyers from New England, who seemed determined to take advantage of the summer discount, which began in April. This came first from the far eastern ports, the Sound ports not coming in until a little later. The cold winter apparently had depleted stocks in New England entirely, and with the memory of a hard winter still fresh, dealers and consumers seemed determined to be fully prepared for another similar season. It was August before this rush was well over and trade had settled down.

The summer discount, for the reasons already noted, had little effect on the local trade, which continued about at its usual level. As the winter approached the weather continued exceptionally mild, and in November and December it seemed to be assured that there would be an open winter, in sharp contrast to the severe seasons of 1904 and 1905. Local trade was dull accordingly, the New England trade had been pretty well supplied, so that the year, which had opened with a rush, closed on a dull and quiet market. The possibility that a strike might follow the termination, on April 1, 1906, of the 3 years' agreement made under the auspices of the Anthracite Strike Commission, did not serve to excite any strong interest. The general feeling was that a settlement would be arranged without any serious stoppage of production. Moreover, it was reported and generally believed that the anthracite companies were accumulating large stocks, which would serve to carry the market over any probable disturbance. Later this proved to be a correct opinion.

The concentrated and direct control of the anthracite trade, which exists in fact but not in name, was more than ever apparent in the steadiness of prices and the even distribution of shipments from the mines. In January and February there were some delays on the railroads, caused by snow. For the rest of the year there was little or no trouble in transportation.

The price list for the prepared or domestic sizes was unchanged through the year, except by the summer discounts. The list price was $4.75 for broken and $5 for egg, stove, and chestnut, f. o. b. New York Harbor points. The discount was 50 cents per ton in April, diminishing by 10 cents each month until it disappeared in September. This made the prices for April-August $4.50, $4.60, $4.70, $4.80, and $4.90, respectively. The prices for the steam sizes are not so definitely fixed, since they are sold largely in competition with bituminous coal. In 1905, however, these prices were fairly steady. There was a slight flurry in March, when one or two companies were charged with trying to unload surplus stocks of these sizes. It soon subsided, however, and the agents of the accused companies professed entire ignorance. Prices throughout the year were not far from $3 for pea; $2.25 to $2.50 for buckwheat; $1.45 to $1.55 for rice, or No. 2 buckwheat; $1.30 to $1.35 for barley, or No. 3 buckwheat; all f. o. b. New York Harbor ports. For house deliveries retail dealers add from $1 to $1.25 per ton to these prices, so that the price of egg, stove, and chestnut to consumers buying by the ton ranged from $5.75 to $6.25, delivered. For small deliveries the cost runs up much higher.

There were no special changes in the trade during the year. The control of the New York, Ontario and Western by the New York, New Haven and Hartford Company had thus far made little or no difference in the course of trade, chiefly because the Poughkeepsie Bridge line, which connects the two roads, is not yet in a condition to handle a heavy coal traffic. Other incidents of the trade were the purchase of Coxe Brothers & Co. by the Lehigh Valley Company; of the Jermyn estate by the Erie, and of the Simpson property by the Ontario and Western. There was also the purchase of a number of small tracts and undeveloped properties by two organizations known as the Schuylkill Coal Company and the Shankeroth Coal Company, which are reported to be acting in the interest of the Delaware and Hudson Company. The only important properties in the anthracite region not controlled by the great transportation companies are those of G. B. Markle & Co. and the Lehigh Coal and Navigation Company. The stock of the last-named company, which was pooled about the end of 1904, in anticipation of a sale, is still in trust, but no deal has been effected. These movements are all in the direction of concentrated ownership and control of the trade.

The bureau of statistics reports the shipments of anthracite coal from New York Harbor ports in 1905 at 14,922,173 tons. This includes only shipments by water, and not such direct car deliveries as are made in the New York district.

The bituminous coal trade of New York includes properly, not only the city itself, but the country along Long Island Sound and that served from the Sound ports, while heavy shipments are made beyond this district to the East. New York Harbor embraces the coal-shipping docks scattered along the New Jersey shore from South Amboy to Weehawken, where deliveries are made to the craft which carry the coal to the city itself and to the points above indicated. The supplies come by rail to New York Harbor from the Clearfield and Broad Top regions in central Pennsylvania, from the Cumberland or Georges Creek region in Maryland, and from some districts in western Pennsylvania. West Virginia coal reaches New York mainly by water from Newport News and Norfolk. The Beech Creek or Northern Clearfield coal does not come to New York, but goes to the large cities in central and western New York, while the Pennsylvania Railroad controls the city and harbor trade for Clearfield coal. The bunker trade—the supply of coal to steamers, coastwise and foreign—at New York is practically in the hands of two or three large concerns, and is chiefly supplied from western Pennsylvania. For the general trade of New York the standard is usually good-grade Clearfield. Cumberland or Georges Creek coal has a special trade of its own, which, apparently, can not be disturbed, and it commands a higher price than Clearfield. Moreover, Georges Creek coal usually is delivered on yearly contracts and does not appear in the general competitive market.

The opening of 1905 found the trade rather disorganized by the severe winter, which had increased consumption, on the one hand, while on the other, deliveries had been interrupted by snow on the railroads and by stormy weather and unusually heavy ice in the ports. In some cases these delays were so serious that opportunity was given for speculation, and sales of coal that happened to be available for prompt deliveries were made at prices running to 25 and 30 cents a ton above the current market rates. This condition, however, gradually passed away with the coming of spring.

A large proportion of the New York trade is done on yearly contracts, and April 1 is the accepted date for the beginning of the contract year. As that date approached there was some anxiety felt, as it had been reported that railroad rates would be advanced. This was dispelled by the announcement that there would be no change. The Pennsylvania made its rates as before, $1.50 f. o. b. New York Harbor for Clearfield, $1.65 for Cumberland, and $1.75 on Westmoreland gas and western Pennsylvania coals, while the Norfolk and Western and the Chesapeake and Ohio continued the old rate of $1.35 to Lamberts Point and Newport News, respectively.

A feature of the contracting season was the absence of that aggressive competition between Pennsylvania and West Virginia coals, which had resulted in breaking prices at times in 1903 and 1904. West Virginia coal, indeed, was less in evidence last year in the New York trade than it had been for several years previously. Some dealers ascribed this to the fact that community of interest in the trade was beginning to work. At any rate the contract season passed smoothly, prices being generally fixed on the basis of $2.70 New York Harbor for good-grade Clearfield, with variations of 5 to 10 cents either way on coals of special quality, or on those a little off first grade. This made a price of $1.15 to $1.25 at the mines for average grades. Contracting was heavier than in the previous year. Manufacturers seemed to be generally assured that their requirements would be large; perhaps, also, they felt that there would be little chance of advantage to be gained by waiting for turns in the market. This left the quantity of open coal for sale during the year less than usual. The larger contracts were especially noticeable among the New England manufacturers, who seemed to be bent on securing larger stocks than usual. The proportion of contract to open coal in the Sound and New England trade was larger than ever before known.

After the winter troubles had passed away and the railroads and ports were free from obstruction the bituminous trade was interfered with to some extent by the rush of anthracite to the ports. For a time this interference was so serious that the railroads had to take strenuous measures, holding back shipments and charging demurrage on cars. It took some time to regulate matters, and it was in July before the trade was in full swing. From that time on, however, it ran smoothly, and there was little delay in shipments. Railroad transportation from the mines was unusually good and prompt throughout the summer, and it has seldom been the case that so few complaints were heard on this point. There were some criticisms on car supply heard, as there always are, but these were not so loud as usual. In part they were due to the fact that trade was so active; the railroads were forced to keep a close watch on the car movement and to refuse cars to points where there was any delay in loading or returning.

The all-rail trade to western New England points was large, like the coastwise trade. Up to August this trade ran smoothly enough. In September, however, the yearly trouble on account of car service broke out, and several of the coal roads put an embargo on all cars consigned to points on one of the New England roads, because cars once on its line are always slow in returning, and at times these delays become exasperating, an embargo being the usual remedy tried.

The supply of vessels for the coastwise trade from New York Harbor points was generally good throughout the year. This was especially the case with the larger vessels; during the summer there was some scarcity of the smaller boats which take cargoes for the shoal-water ports. Freight rates were fairly even and steady, with the exception of a break in August, when there was a temporary oversupply of tonnage. This did not last long, however. Vessels generally demanded the loading and discharging clause in charters, providing for extra payment in case of delay at shipping or receiving ports.

A few years ago it was a common prediction that the system of shipping by barges, convoyed by large tugs, would soon command the entire coastwise coal trade. These are no longer heard; there are many barges in the trade, but the number of sailing vessels employed does not decrease.

The closing months of 1905 showed an unusually active trade for the season. Manufacturers' requirements for coal continued large, and reports began to be circulated of a possible or probable strike in the spring on the expiration of the miners' agreements. This led to a general desire to lay in stocks ahead as far as possible and brought about a condition of trade which has seldom been equaled in November and December. The extremely mild and open winter did not affect the demand for steam coal for manufacturers' uses, while it favored the free movement of coal from the mines. There were no obstructions on the railroads, and December showed almost as steady and prompt movement as July. The result was that the year closed with larger accumulated stocks throughout New York territory than have ever been known to exist.

The marked feature of the year throughout was the steadiness of prices. With the exception of the comparatively small speculative sales in February and March, the basis throughout the year varied very little from $2.60 to $2.75 f. o. b. New York Harbor for good grade Clearfield—that is, from the basis established by the spring contracts. The volume of trade was also large, in spite of the fact that the small or steam sizes of anthracite were much in evidence. Upon the whole, the year was a good one for the trade.

No record is accessible of the actual receipts of bituminous coal at New York by the several lines. The Bureau of Statistics reports the shipments of bituminous coal from the New York Harbor points for the year 1905 at 9,076,306 tons, an average of 756,359 tons per month. This would not include bunker coal or direct car deliveries, nor would it include the large deliveries to Jersey City, Newark, Paterson, and other manufacturing towns, which are really in the New York district.

BOSTON, MASS.

Mr. Daniel D. Morss, who has succeeded Mr. Elwyn G. Preston as secretary of the Boston Chamber of Commerce, has prepared for this report the following review of the coal trade of that city in 1905:

The coal trade of Boston opened the year 1905 with only moderate stocks in distributers' hands and with a fairly good demand from consumers, most of whom were contented to supply immediate needs only, as prices offered no inducement to stock up in advance of wants.

Bad weather in January delayed receipts by water, and a scarcity of cars for rail shipments strengthened the market temporarily, but with the approach of spring buyers were inclined to hold off until the season's prices were fixed in April.

With the decline heavy orders were placed for the earliest possible shipment, so that the "cif." cost might be made as low as possible. Later, as the monthly advances of 10 cents per ton per month were established, the demand for prompt shipment became less urgent, and it is stated that some cargoes of anthracite already afloat were placed by commission houses at something under schedule rates.

The total receipts of anthracite for the year 1905 were 1,977,398 long tons, against 2,002,779 long tons in 1904, and were the smallest for any year since 1898 with the exception of 1902, which year should properly be omitted from all comparative statements.

The gross receipts of bituminous coal, however, show a gain over 1904 of 340,888 tons, from 3,065,873 tons in 1904 to 3,406,761 tons in 1905, but still fall behind 1903 by 83,202 tons.

The net receipts of anthracite for local consumption are practically unchanged from 1904, while the whole increase in receipts of bituminous went into local consumption.

The following table shows the receipts of both anthracite and bituminous coal in detail for the last year, compared with the total receipts in 1904—the amounts received at Boston and forwarded to New England points and the net receipts at Boston (for local consumption):

Monthly receipts of coal at Boston, Mass., for 1905, with comparisons.

[Long tons.]

Month.	Receipts, all routes.		Amount forwarded to New England points.		Net receipts (for local consumption).	
	Anthracite.	Bituminous.	Anthracite.	Bituminous.	Anthracite.	Bituminous.
January	129,122	243,324	17,678	82,837	114,444	160,487
February	86,786	174,716	22,534	78,034	64,252	96,682
March	171,676	338,384	14,145	88,577	157,531	249,807
April	206,399	287,667	29,506	89,442	176,893	198,225
May	204,531	318,550	29,693	100,045	174,838	218,505
June	190,053	343,500	23,836	106,370	166,217	237,130
July	143,544	272,936	20,589	94,440	122,955	178,496
August	129,156	287,866	12,958	99,192	116,198	188,674
September	158,699	274,217	13,413	93,678	145,286	180,539
October	192,536	295,617	20,487	97,729	172,049	197,888
November	181,556	288,615	28,579	84,103	152,977	204,512
December	183,340	281,369	21,147	79,432	162,193	201,937
Total, 1905	1,977,398	3,406,761	254,565	1,093,879	1,722,833	2,312,882
Total, 1904	2,002,779	3,065,873	269,105	1,094,665	1,733,674	1,971,208
Total, 1903	2,173,977	3,489,963	277,093	915,697	1,896,884	2,574,266
Total, 1902	1,057,170	3,226,028	108,209	762,593	948,961	2,463,435
Total, 1901	2,163,558	2,648,861	333,178	792,225	1,830,380	1,856,636

The receipts of both anthracite and bituminous coal at Boston by rail shows a further decline and aggregate only 77,024 tons out of a total of 5,384,159, or only a little less than $1\frac{1}{2}$ per cent.

The receipts of foreign coal are practically limited to the supply of gas coal from the provinces, but these total 608,471 tons against 550,383 tons in 1904, and are the largest normal receipts for any year. The extraordinary receipts of 1901 and 1902 were, of course, the result of importations to fill the gap in supplies resulting from the coal strike, and the consequent suspension of the tariff on foreign coal.

The following table shows the receipts of domestic and foreign coal at Boston by water and by rail for a series of 5 years:

Receipts of coal at Boston, Mass., for five years.

[Long tons.]

Year.	Domestic. By water. Anthracite.	Domestic. By water. Bituminous.	Domestic. All rail. Anthracite.	Domestic. All rail. Bituminous.	Foreign. Anthracite.	Foreign. Bituminous.	Total.
1901	2,139,989	2,063,691	23,569	47,139	....	538,031	4,812,419
1902	974,649	2,103,696	40,755	120,812	41,766	1,001,520	4,283,198
1903	2,042,512	2,078,499	109,033	185,330	22,432	1,226,134	5,663,940
1904	1,961,785	2,397,885	40,994	117,605	....	550,383	5,068,652
1905	1,941,478	2,757,186	35,920	41,104	....	608,471	5,384,159

No foreign anthracite coal received in 1904 and 1905.

The coastwise coal freights have been comparatively steady throughout the year, at a somewhat lower average than in 1904. The market has been apparently an open one, without combination or manipulation, and fluctuations in rates have been governed by the natural laws of supply and demand.

While the barge rate from New York was nominally 50 cents during the greater part of the summer, vessel rates ranged from 55 cents minimum to 80 cents maximum. Hampton Roads and Philadelphia rates ranged from 65 to 85 cents per ton, while Baltimore rates were quoted from 65 to 95 cents. The average range in rates was about 25 cents per ton.

Retail prices of anthracite coal at the opening of the year were as follows: Stove and chestnut, \$7; egg, \$6.75; furnace, \$6.50; pea, \$5. These prices ruled unchanged until the middle of April, when the schedule prices of all sizes, except pea coal, were reduced 25 cents, the latter remaining unchanged. No further change was made until November 18, when an advance of 50 cents per ton was established all around, with the exception of pea, which was raised 25 cents. These prices prevailed for the balance of the year.

The f. o. b. price of Pocahontas coal at Newport News was \$2.60 per ton from January 1 to April 1, \$2.50 from April 1 to October 1, and \$2.60 from October 1 to December 1, to which must be added the current rate of freight, varying, as shown in the table herewith, from 65 cents per ton minimum May 4 to 85 cents per ton maximum, which was reached on January 13 and again on December 15.

Coal freights to Boston during 1905.

From—	Minimum. Rate.	Minimum. Date.	Maximum. Rate.	Maximum. Date.
	Cents.		*Cents.*	
New York	55	July 30	80	December 10.
Philadelphia	60	July 20–August 10	85	December 26.
Baltimore	65	August 15	95	December 20.
Norfolk and Newport News.	65	May 4	85	January 13 and December 15.

PHILADELPHIA, PA.

The following review of the coal trade of Philadelphia during 1905 has been prepared for this report by Mr. Samuel R. Kirkpatrick, representative of the New York News Bureau in Philadelphia.

The year 1905 was a record-breaking one in the production of anthracite coal. The output of all the mines exceeded that of any other year, and the shipments to the various cities that depend on hard coal for their fuel were larger than ever. Although since the anthracite coal strike of 1902 there has been a decided advance in the retail price to the consumer, there has also been a large increase in the amount of coal consumed. The increase in the eastern cities is a natural one, but the increase in the western cities is accredited to the fact that the coal companies are sending out agents to secure business from places that have heretofore been neglected. The strike of 1902 taught the consumer a lesson in more ways than one. It showed them that it was good policy to always have a stock on hand and also how to economize in the use of the fuel. Early in 1905 it was apparent that a new agreement would have to be made between the miners and operators. This led to the laying in by the consumer of a large amount of coal, much more than was usually the case. As the previous winter was a very severe one many housekeepers had to purchase a supply in the middle of the season. It is evident that more than that required for immediate needs was bought, so that if the weather was severe there would be enough coal to last through the cold season. However, the winter of 1905–6 was a mild one, and the quantity of anthracite consumed was fully one-third less than what it was during the previous winter. Notwithstanding the mild winter it is believed there was a greater quantity of anthracite consumed than ever before. At the close of the year the retail dealers were practically out of orders and the demand was only fair. Had the winter of 1905–6 been as severe as the previous one the consumption would undoubtedly have been much greater, and the demand would have compelled the coal companies to work their mines to their utmost capacity.

For domestic use anthracite coal is the only fuel used in Philadelphia, and the bituminous coal consumed is for factory use exclusively. There is considerably more bituminous fuel used by the manufacturing establishments than was used prior to the strike of 1902.

The anthracite coal companies produced in 1905 the largest amount of coal in the history of anthracite mining. Naturally a large amount of this output was steam sizes, and while there was a fair demand for all sizes below pea, the production was so large that before the end of the third quarter the supply of these sizes amounted to many million of tons. The piles of small sizes accumulated so fast that extra efforts were made to get rid of some of these coals. At no time did there seem to be an excess of prepared sizes. The coal companies, with the exception of the individual operators, maintained prices. The cutting was of small lots, and were made when there was no demand and by the companies that had no room to store the coal.

The year 1905 was in some respects similar to that of 1904. As soon as the regular spring reduction was made in April of 50 cents a ton there was a rush of orders and the coal companies had more than they could fill, the consequence being that many orders had to go over until the following month, when an additional 10 cents was added. For the months of May, June, July, and part of August the demand for prepared sizes was equal to the production, but after that time and until November the trade had a resting time. There was, however, little let up to the production and what coal was not sold was put into stock. Toward the latter part of summer there was some cutting of prices on pea and other small sizes. This reduction was made by one of the large coal companies, and at one time it looked as if a general coal war would be the result. It was avoided by a restoration of prices after a conference. The few days the reduced prices were in effect caused considerable uneasiness, and the company that made the reduction booked a large number of orders. This somewhat unsettled the market and made the demand for steam sizes after the restoration less than what it was before the cut was made.

Philadelphia is one of the greatest shipping ports for anthracite and bituminous coal in the East. The bulk of the business is done by three companies, and each year they are adding greater facilities for the prompt handling of an increasing business. The Philadelphia and Reading Railway Company's piers at Port Richmond are about the finest in the country. Here this company sends millions of tons away each year. Most of this business is done in the company's own boats, and besides handling anthracite coal it has shown a great increase in its bituminous tonnage. The Pennsylvania Railroad Company has increased the shipping facilities at its Greenwich piers, and the Baltimore and Ohio also shows a steady increase in its coastwise tonnage. The amount of anthracite shipped to this city in 1905 was only a little less than it was during the previous year. There was a good demand for domestic sizes of coal during the year. Toward the close of 1905 the dealers began to stock up, and at the end of the year it is said they had on hand more coal than ever before. Besides this the amount of coal in the bins of the consumers was also larger, and the weather was so mild much less coal was burned than is generally done in December. During all the time the accumulation of steam sizes was going on, and on December 31, 1905, it is claimed that the stocks of buckwheat, rice, and pea were much larger than the companies cared to carry. The accumulation of these sizes gave the coal companies considerable concern and many schemes were enacted to get rid of the surplus. The demand for prepared sizes naturally created an increasing pile of smaller sizes, and the demand for these was not enough to take what was produced.

There was a decrease in the consumption of anthracite during the year 1905 as compared with 1904. The amount of anthracite consumed in this city in 1905 was 4,371,478 long tons, as compared with 4,382,949 long tons in the previous year. This decrease was to be expected in a year when everything was against the large consumption of anthracite. The months of November and December were mild and more like fall than winter. There was more bituminous coal used than in the previous year. The consumption of this fuel in 1905 was 2,143,024 tons, as compared with 1,891,885 in 1904, being an increase of 251,139 tons. The increase in the use of bituminous coal was brought about by a greater quantity being used by the large manufacturing establishments. Nearly all the manufacturing plants were working, and in many cases they were being operated to their full capacity. In the previous year a number were shut down.

The coal and railroad companies were better prepared to handle a large output of anthracite and bituminous coal during 1905 than ever before, and this was necessary, as for months at a time the coal companies produced over 5,000,000 long tons. A few years ago such a production was considered impossible, and when 5,000,000 was reached the companies seemed unable to handle the output. There were not enough cars to transport the product, and conditions around the breakers became congested. Now a better system prevails, and as each company has added more cars to its equipment the coal can be more readily taken care of. The total production for 1905 was the largest in the history of anthracite mining, although the companies during the latter part of the year curtailed the output by reducing the working hours of the mines. For a few weeks the mines were shut down several days in each week. The total shipments of anthracite to this city in 1905 were 6,243,089 long tons, as compared with 6,134,556 tons in the previous year, an increase of 108,533 tons. The shipments of bituminous in 1905 were 6,658,320 long tons, as against 5,808,437 tons in 1904. There was an increase in the shipments of bituminous coal for export of 127,136 tons, an increase in coastwise and harbor shipments of 471,608 tons and an increase in local consumption of 251,139 tons.

The coal companies do not, as formerly, issue monthly circulars. The price is fixed, and each April there is a reduction of 50 cents a ton. This price only applies to coal delivered that month. In May an advance of 10 cents is made; in June 10 cents more; July still another 10 cents, and in August the last 10 cents, so that in September the regular circular price is again in force.

The Philadelphia and Reading Railway Company is rapidly forging ahead as the leading coal carrier. It has always carried the largest tonnage of anthracite, and during the year 1905 it maintained its lead in the transportation of this fuel and also did a large bituminous business. The Reading Railway has a large number of industries along its system and when they are all working to their full capacity, as they were in 1905, a large amount of coal is consumed. The Reading is now a factor in the soft-coal movement, and it is believed that the day is not far off when bituminous tonnage carried by it will exceed its haulage of anthracite.

Although the manufacturing industries of this State were generally in full blast during the year 1905 some cutting was indulged in by both the bituminous and anthracite coal companies. The cutting by the hard-coal companies was limited, but was more general among the bituminous operators. For a time soft coal was a drug on the market and prices rapidly fell. Many manufacturers had laid in large supplies and when this stocking up was completed a surplus was created, so that circular prices could not be maintained. Soft coal can not be stored like anthracite without deterioration and producers were anxious to get rid of their output. In some instances the reduction amounted to from 50 to 70 cents below the circular prices and it is said that for a time the coal could be bought for a little over $1 a ton at the mines. The anthracite coal companies endeavored to get back some of the trade they lost through the strike of 1902 and this effort was in a measure unsettling to the bituminous trade. There were more steam sizes of anthracite on hand on December 31, 1905, than ever before. It is estimated that the various coal companies had at least 4,000,000 tons of steam sizes stored up on that date. There was little trouble experienced by the bituminous coal companies in securing enough cars to handle their business. The railroads have more cars now than ever before and the distribution is better. The anthracite coal companies are closely allied to the railroad companies, and the question of car distribution is not so much of a disturbing factor. Toward the latter part of the fall, however, there was a period when even the anthracite mines had to be shut down, owing to the short supply of cars. During that time the trade was dull and many of the cars were being utilized for storage purposes.

There was a falling off in the exports of anthracite to foreign countries. The foreign shipments of hard coal amounted to 40,414 tons, the largest amount being shipped to Cuba, there being sent to that country from this city 21,993 tons, as against 19,087 tons in 1903. There were 400 tons sent to Mexico, 7,755 to Newfoundland, and 5,952 to Nova Scotia; 475 tons were shipped to Haiti, 2,971 to Quebec, and 645 tons to the Bermuda Islands. The export shipments of bituminous were larger than the previous year. There is quite a large trade being built up between this city and Cuba. In 1905 the shipments of soft coal to Cuba were 375,660, as against 322,368 in 1904. Mexico took 156,992 tons, the British West Indies 18,203, the Danish West Indies 66,609, and the French West Indies 36,440 tons; 8,022 tons were sent to South America, 11,008 tons to Newfoundland, and 2,500 tons to France. In 1905 31,200 tons were sent to the Philippine Islands. In the previous year there was no coal sent from this city to the country's new possessions in the Pacific Ocean. The total valuation of anthracite coal exported was $180,695 and that of bituminous $1,922,584.

Each year a larger amount of pea coal is used for household purposes. Many housekeepers are using this size coal not only for cooking purposes but for the heater as well. This is about the only small size that has maintained an increase in consumption. The other sizes while being produced in much greater quantity were less in demand. The large coal companies seem to have considerable trouble in supply- the demand for pea coal. It is believed that within a few more years the consumption of this size for domestic purposes will be greatly increased. There are many who are now using it in their furnaces and the reports made by them are quite favorable. However, pea coal will never take the place of stove and chestnut and its increase in use is mostly due to it being cheaper in price than the prepared sizes.

Notwithstanding the great amount of steam sizes on hand at the close of the year prices were held firm and all the companies were working in harmony.

The following are the prices of the smaller sizes of anthracite coal at the mines for each month of 1905:

Prices for steam sizes of anthracite at the mines during 1905, by months.

[Per long ton.]

Month.	Pea.	Buckwheat.	Rice.
January	$1.40-$1.75	$0.80-$1.25	$0.40-$0.75
February	1.40- 1.75	.80- 1.25	.40- .75
March	1.40- 1.75	.80- 1,25	.40- .75
April	1.40- 1.75	.80- 1.25	.40- .60
May	1.40- 1.65	.80- 1.10	.40- .60
June	1.30- 1.50	.80- 1.10	.40- .55
July	1.20- 1.50	.70- 1.00	.35- .55
August	1.20- 1.50	.70- 1.00	.30- .60
September	1.20- 1.50	.65- 1.00	.30- .60
October	1.35- 1.50	.75- 1.00	.40- .60
November	1.40- 1.75	.85- 1.25	.50- .65
December	1.50- 1.85	.85- 1.25	.50- .75

There was no change in freight rates for local delivery during the year. The charges per ton, which vary according to the region from which the shipment is made and according to size of coal, were as follows:

Freight rates on anthracite coal from regions to Philadelphia, Pa.

[Per long ton.]

Region.	Prepared sizes.	Pea.	Buckwheat.
Schuylkill	$1.70	$1.40	$1.25
Lehigh	1.75	1.45	1.30
Wyoming	1.80	1.50	1.35

Through the courtesy of the officers of the Pennsylvania Railroad Company, the Philadelphia and Reading Railway Company, the Lehigh Coal and Navigation Company, and the Baltimore and Ohio Railroad Company, data have been furnished from which the following table has been compiled. It shows the distribution of coal at Philadelphia for the export trade, the coastwise and harbor trade, and the Philadelphia local trade.

Distribution of coal at Philadelphia, Pa., in 1904 and 1905.

[Long tons.]

Destination.	1904.		1905.	
	Anthracite.	Bituminous.	Anthracite.	Bituminous.
Export	43,630	576,290	40,414	703,426
Coastwise and harbor	1,707,977	3,340,262	1,831,197	3,811,870
Local	4,382,949	1,891,885	4,371,478	2,143,024
Total	6,134,556	5,808,437	6,243,089	6,658,320

The price circular of the Philadelphia and Reading Coal and Iron Company, which is the same as other companies, is as follows:

Circular prices for anthracite coal in Philadelphia, Pa., during 1903, 1904, and 1905.

Size.	1903.		1904.		1905.	
	April.	September.	April.	September.	April.	September.
Lump and steamboat	$3.25	$3.75	$3.00	$3.00	$3.00	$3.00
Broken	3.00	3.50	3.00	3.50	3.00	3.50
Egg	3.25	3.75	3.25	3.75	3.25	3.75
Stove	3.25	3.75	3.25	3.75	3.25	3.75
Chestnut	3.25	3.75	3.25	3.75	3.25	3.75
Pea	2.00	2.00	2.00	2.00	1.50	1.50
Buckwheat	1.75	1.75	1.50	1.50	1.00	1.00

BALTIMORE, MD.

The following review of the coal trade of Baltimore in 1905 has been prepared by Mr. Maurice J. Lunn, editor of Coal and Coke:

Notwithstanding the fact that the coal trade of Baltimore had some drawbacks during the year 1905, more particularly in the bituminous coal business, the year, as a whole, may be said to have been a prosperous one.

The winter of 1904–5 was quite severe, with resulting scarcity in the car supply and slow movements of the available cars, owing to the motive power being operated at a low capacity, all of which conditions had a beneficial effect upon the coal trade.

Anthracite trade.—In the anthracite trade the prices were firm throughout the year, and in some cases they were slightly above the schedule. Although the winter of 1904–5 was one of the most severe in the history of this section of the country, the consumer fared very well owing to the fact that both he and the retail dealer had prepared for the emergency by laying in a pretty good supply in the fall and early winter, and this branch of the coal business was conducted upon an even basis under profitable conditions. There was more or less trouble in making deliveries to the residential districts, owing to the frequent and heavy snows, but taking it in its entirety the hard-coal trade was conducted satisfactorily to both the consumer and the dealer, with a good profit to the latter. The late spring resulted in the healthy winter demand being somewhat extended, necessitating the consumer replenishing his stock, which, of course, tended to increase the demand beyond the usual winter requirements.

The business in the anthracite trade immediately after April 1, with the view of taking advantage of the discount of 50 cents per ton, was quite brisk, followed a month or two later by a decided inactivity which lasted until late in the summer or early fall, when the householder began to lay in his winter supply, at the same time having in view the possibility of a coal strike. This gave quite an impetus to the demand which continued throughout the fall of 1905 and over into the first few months of 1906, in spite of the fact that with the exception of a few days the weather was unusually mild. While the weather was marked in comparison with the preceding winter, there was an increase in the amount of business done.

Bituminous trade.—While the year started in with a good demand for bituminous coal, brought about in greater or lesser degree by the scarcity of cars, supplemented by a general freeze-up which greatly curtailed or absolutely prohibited shipments by water, prices were not all satisfactory to the producer. With the opening of the weather later there was a large amount of bituminous coal contracted for, resulting in a large coastwise and foreign shipment, but prices continued to go lower, the summer months experiencing a depressed state for this branch of the industry, although the tonnage was larger than heretofore.

In the early fall, however, better prices prevailed, due in part to a rather serious car shortage, with spot coal rather scarce and the larger operators finding themselves sufficiently employed in caring for their contracts. An unusually large grain movement also had its effect on the coal trade, which, together with increased activity in the manufacturing establishments, brought about a brisk demand for coal.

There has been an increase in the demand for fuel for manufacturing purposes, owing to the inauguration of new establishments since the 1904 fire, and there has also been a marked increase in the coastwise shipments and exports. The coastwise shipments from Baltimore in 1903 were 1,731,869 tons; in 1904 they were 2,302,788 tons, and in 1905 they amounted to 3,084,889 tons; all bituminous coal with the exception of about 250,000 tons of anthracite coal per annum. In domestic exports of coal, all bituminous, this port is credited with 116,294 tons in 1903, 150,912 tons in 1904, and 341,107 tons in 1905, showing a decided increase in the coastwise and export business during the past three years.

The following statement gives the coastwise and export shipments from this port for the last three years:

Coastwise coal shipments from Baltimore, Md.

[Long tons.]

	Total.	Anthracite.	Bituminous.
1903	1,731,896		
1904	2,302,788	238,728	2,064,060
1905	3,084,889	252,568	2,832,321

Domestic exports of bituminous coal from Baltimore, Md.

	Long tons.
1903	116,294
1904	150,912
1905	341,107

While the shortage of transportation has no doubt had its effect, the natural growing demand has played its part in the general improvement. Besides this the strike talk probably had some effect on the trade during the last month or two of the year. The demand of the past year has not been at all abnormal, and it is confidently expected that the year 1906 wiil show even better results in the coal tonnage of Baltimore.

From a tonnage standpoint there is no cause of complaint, but with the large tonnage of bituminous coal being mined and the extension of facilities for increasing the same comes the necessity for more businesslike arrangements in the mercantile end of the business. The history of the soft coal trade of the past year especially emphasizes this point.

The receipts and shipments of anthracite and bituminous coal for 1905 were as follows:

Receipts and shipments of coal at Baltimore, Md., in 1905.

[Long tons.]

	Receipts.	Tide-water shipments.	
		Coastwise.	Exports.
Bituminous	3,861,917	2,832,321	341,107
Anthracite	751,097	252,568	
Total	4,613,014	3,084,889	341,107

In computing the coal tonnage of the port of Baltimore it is only fair to include the receipts of coal at the plants of the Maryland Steel Company at Sparrow Point, Md., about 9 miles from the city, and the Central Foundry Company, located at Dundalk, Md., about 6 miles out of the city. These figures are not included in the above statement.

Mr. F. W. Wood, president of the Maryland Steel Company, states that their consumption of bituminous coal for all purposes during 1905 amounted to 632,450 long tons, as compared with 596,738 tons in the previous year, while they consumed 53,990 long tons of coke during the year, purchased from outside sources, in addition to the amount of coke manufactured at their own ovens at their plant.

Mr. J. W. Voorhis, manager of the Central Foundry Company, advises that there were consumed at their plant during the past year 4,183 short tons of coke and 2,863 short tons of coal, as compared with 3,575 short tons of coke and 2,009 short tons of coal in the preceding year.

PITTSBURG, PA.

The following table, which presents the statement of the amount of coal shipped to the city of Pittsburg, and through that center to other points, has been compiled from reports made to the Geological Survey by officials of the railroads entering Pittsburg and by the United States army officer in charge of the slack-water navigation on the Monongahela River and of the improvements under way at Davis Island dam, on the Ohio River below Pittsburg. The railroad officials furnishing the information for this report, and to whom special acknowledgment is due, are Messrs. J. G. Searles, general coal freight agent of the Pennsylvania Railroad, Philadelphia, Pa.; W. L. Cromlish, coal and coke agent of the Baltimore and Ohio Railroad, Pittsburg, Pa.; C. F. Perkins, general ore and coal agent, Pennsylvania lines west of Pittsburg, Pittsburg, Pa.; W. A. Terry, general freight agent, Pittsburgh and Lake Erie Railroad, Pittsburg, Pa.; J. B. Safford, superintendent Pittsburgh, Chartiers and Youghiogheny Railway, Pittsburg, Pa., and H. J. Booth, general freight agent, Wheeling and Lake Erie Railroad, Pittsburg, Pa. The statistics of the movement of coal through the Monongahela locks and the Davis Island dam, on the Ohio River below Pittsburg, have been furnished by Maj. William L. Sibert, Corps of Engineers, U. S. Army. The statement for 1905 includes the shipments over the Wabash-Pittsburg connections which have not been previously reported, and shows a total gain in business over 1904 of nearly 5,500,000 tons. Of the total movement to and through Pittsburg in 1905, 9,484,860 short tons, or about 35 per cent, was river coal.

Shipments of coal to and through Pittsburg from 1901 to 1905.

[Short tons.]

Transportation route.	1901.	1902.	1903.	1904.	1905.
Pennsylvania R. R.:					
To Pittsburg and vicinity	2,051,361	2,062,422	1,851,348	1,968,596	b 2,126,670
To west of Pittsburg	1,407,643	1,701,431	2,211,347	2,386,163	b 2,728,232
Baltimore and Ohio R. R.:					
To Pittsburg district	464,204	580,241	442,866	545,720	597,280
To west of Pittsburg	1,157,966	1,231,314	1,305,565	1,190,568	1,387,215
Pittsburg, Cincinnati, Chicago and St. Louis R. R	3,933,601	4,965,541	5,068,885	5,689,611	6,098,553
Allegheny Valley Rwy.:					
To Pittsburg district	163,809	163,303	96,377	91,101	(c)
To west of Pittsburg	19,755	15,602	47,895	53,584	(c)
Pittsburgh and Lake Erie R. R.:					
Local and Pittsburg	1,789,327	8,873,150	9,775,667	8,929,868	9,467,360
To west of Pittsburg	5,367,980				
Pittsburgh, Chartiers and Youghiogheny Rwy.a	410,764	360,763	325,767	245,651	372,222
Wheeling and Lake Erie R. R	....	....	....	....	d 1,055,848
Monongahela River locks:					
To Pittsburg district	b 4,662,127	5,686,022	6,303,365	4,173,992	5,558,541
To west of Pittsburg	3,283,353	3,619,905	3,069,299	2,811,584	3,926,319
Total shipments	23,411,890	29,259,694	30,498,381	28,086,438	33,318,240
Approximate local consumption	9,430,000	12,950,000	15,500,000	12,500,000	17,500,000

a Exclusive of tonnage delivered to Pittsburgh and Lake Erie Railroad, which is included in shipments reported by that company.
b Includes shipments over the Allegheny Valley Railroad, now practically a part of the Pennsylvania system.
c Included in Pennsylvania Railroad shipments.
d West Side Belt, and Wabash Pittsburg Terminal railways.

MONONGAHELA RIVER SHIPMENTS.

Maj. William L. Sibert, Corps of Engineers, U. S. Army, reports the amount of coal passing through the locks of the Monongahela River in 1905 at 9,484,860 short tons, against 6,985,576 tons in 1904 and 9,372,664 tons in 1903. The local consumption of river coal in 1905, including the amount consumed at the iron and steel works, along the first and second pools of the Monongahela River amounted to 5,558,541 short tons, as compared with 4,173,992 tons in 1904 and 6,303,365 tons in 1903, while the coal passing through Davis Island dam increased from 2,811,584 short tons in 1904 to 3,926,319 tons in 1905.

Movements of coal through Monongahela River locks and Davis Island dam, 1901–1905.

[Short tons.]

Year.	Passed through locks on Monongahela River.	Passed Davis Island dam, Ohio River, Near Pittsburg. (From annual reports, Ohio River, improvement.)	Difference, approximate consumption of river coal at Pittsburg.
1901	7,945,480	3,283,353	4,662,127
1902	a 9,305,927	3,619,905	5,686,022
1903	9,372,664	3,069,299	6,303,365
1904	6,985,576	2,811,584	4,173,992
1905	9,484,860	3,926,319	5,558,541

a The coal traffic on the Monongahela is obtained by adding to that which passes Lock No. 3, the coal mined and shipped in pools Nos. 1 and 2. In 1905 there were consumed in pools Nos. 1 and 2 4,067,120 tons river coal, in the harbor below No. 1, including the Allegheny River, 1,491,421 tons of Monongahela River coal, a total of 5,558,541 tons.

CLEVELAND, OHIO.

The total receipts of coal and coke in Cleveland, as reported by Mr. Munson A. Havens, secretary of the chamber of commerce, amounted in 1905 to 5,724,638 short tons, a decrease of 416,846 tons as compared with 1904, when the receipts were 6,141,484 short tons. The receipts in 1905 included 4,846,162 tons of bituminous coal, 295,423 tons of anthracite, and 583,053 tons of coke. The decrease in the coal movement at Cleveland was altogether in business passing through the city, the shipments from the city, nearly all of which is by lake, showing a decrease from 3,135,548 short tons in 1904 to 2,664,092 tons in 1905. The local consumption (the difference between the receipts and the shipments) increased almost 55,000 tons, from 3,005,936 short tons in 1904 to 3,060,546 short tons in 1905.

The following tables show the amounts of bituminous and anthracite coal and coke received and shipped at Cleveland during the last five years and the total receipts and shipments since 1888:

Coal and coke receipts and shipments at Cleveland, Ohio, 1901–1905.

RECEIPTS.

[Short tons.]

Kind.	1901.	1902.	1903.	1904.	1905.
Bituminous	3,996,493	4,949,027	5,577,964	5,347,476	4,846,162
Anthracite	326,741	158,405	254,193	199,907	295,423
Coke	601,213	737,603	763,430	594,101	583,053
Total	4,924,447	5,845,035	6,595,587	6,141,484	5,724,638

SHIPMENTS.

Kind.	1901.	1902.	1903.	1904.	1905.
Anthracite by rail	18,731	6,214	6,590	27	74
Bituminous by rail	39,240	116,184	62,082	61,047	50,575
Bituminous by lake	1,787,028	2,234,029	2,752,549	3,052,819	2,567,916
Coke by rail	20,678	24,191	18,170	21,655	45,527
Total	1,865,677	2,380,618	2,839,391	3,135,548	2,664,092

Total coal receipts and shipments at Cleveland, Ohio, 1901–1905.

[Short tons.]

Year.	Receipts.	Shipments.
1901	4,924,447	1,865,677
1902	5,845,035	2,380,618
1903	6,595,587	2,839,391
1904	6,141,484	3,135,548
1905	5,724,638	2,664,092

CHICAGO, ILL.

The following review of the coal trade of Chicago in 1905 was compiled by the Chicago bureau of coal statistics and published in the Black Diamond of January 27, 1906:

Many facts stand out in connection with the review of the coal trade at Chicago during the year 1905. Total receipts of anthracite by rail and water were less than the two preceding years. Receipts of bituminous coal by rail slightly exceeded those of 1904, but were less than in 1903. Chicago's trade in coal in the country tributary to this city expanded during the past year, no doubt due to the fact that business conditions were oppressive at times and shipping companies necessarily were obliged to use more active endeavors to find a market for their product, as a consequence of which they invaded the territory tributary to this city. Anthracite movement to the country amounted to 583,643 tons in 1905, as compared with 521,628 tons in 1904. The coal moved in 1905, however, was less than in 1903 by about 23,000 tons, but a comparison of this character is not wholly vital, due to the fact that the trade in 1903 was more or less stimulated by the anthracite strike which had occurred the previous year and the effects of which had not yet worn off.

Shipments of bituminous coal to the country during 1905 were 2,184,037 tons, as compared with 2,097,042 tons in 1904, an increase practically of 85,000 tons. This was not a substantial increase when compared with the aggregate tonnage moved, but at the same time it furnishes a source of some encouragement, inasmuch as two competing centers, namely, Peoria and Milwaukee, perhaps diverted some of the tonnage which normally would have gone through Chicago as a gateway. Another feature which also diverted some tonnage is found in connection with the lower freight rates from the southern Illinois fields to St. Louis, due to material reductions last spring. These freight rates were so much lower that some tonnage was diverted from Chicago as a gateway to St. Louis on movement destined for Missouri river points. Considering all of these circumstances, which had a tendency to divert trade from Chicago, and the fact that the local shipments were increased, the situation on the whole is encouraging. The total movement of bituminous to the country last year was practically identical with that of 1903, which was a banner year in the western trade in the amount of tonnage required.

The local anthracite consumption in Chicago during 1905 was 1,252,816 tons, as compared with 1,322,322 tons in 1904, a decrease practically of 70,000 tons. This does not necessarily indicate that Chicago is becoming less important as an anthracite consuming center, because 1905 throughout recorded a mild, equable temperature, weather conditions naturally reducing the requirements for this grade of coal as compared with previous years. As a matter of fact, when a comparison is made with 1903 it is safe to conclude that progress is being made in the consumption of anthracite commensurate with the growth of the city. In that year the local consumption was only 1,124,879 tons.

In the local consumption of bituminous 6,842,043 tons were required in 1905, as compared with 6,818,354 tons in 1904, a nominal increase of 24,000 tons. Practically the tonnage of the two years was the same. The railroads last year did not require as large a tonnage to move the same volume of traffic as they did the previous year, due to the mild weather in 1905.

While the volume of coal business in Chicago and territory tributary to this city correspondingly was on about the same basis as in the previous year, there were many features which do not appear in connection with the statistical review. In the anthracite trade many householders on April 1 had some surplus left in their bins from the previous winter, due to the smaller consumption resulting from weather conditions. As a consequence they were rather reluctant to purchase coal when it was at the minimum retail price in April and May, and much of the business was crowded into the late summer and early fall. The wholesale car-lot movement in April was fair, but not as active as in the same month the year previous. By the middle of June wholesale demand had become stagnant and did not revive to any great extent until September, when the car shortage became a noticeable feature and caused activity during that month and throughout October, November, and part of December.

REVIEW OF THE BITUMINOUS TRADE.

In the bituminous trade from the 1st of April to the 1st of September the market was in a demoralized condition nearly all of the time. There was scarcely a day during which demurrage coal was not offered from the Illinois and Indiana mines, and part of the time the eastern product from West Virginia, Ohio, and Pennsylvania was on a weak basis, purchasers being able to pick it up at a less figure than the circular price. The suspension in the mines of Illinois in the early part of July, due to the controversy over the shot-firers' law, created a little activity at that time, but so much coal was available from other States that the market did not show any appreciable advance. With the resumption of mining, coal was produced in heavy supply and the demurrage conditions occurred again, prices going to about the lowest point for the year the latter part of August.

There is an adage in the coal trade that market conditions represent "either a feast or a famine." The year 1905 substantiated this principle. The feast, from the standpoint of buyers, occurred prior to September 1. After that time famine conditions prevailed. The car shortage became very stringent about the middle of September, reducing the output of the mines in all of the bituminous States from normal to about 35 to 50 per cent of the usual tonnage. In many districts mines were operated only two or three days each week because cars were not available for loading purposes. This reduction in the tonnage of coal produced soon had its effect on the market, and about the 1st of October the price situation was the strongest since 1903. Domestic lump coal, which went begging in the summer at $1 at the mines, was sold as high as $2.25 and $2.50 at the mines, and buyers were using their utmost efforts to secure it at those figures. Run-of-mine coal for steam purposes, which sold at 75 and 85 cents f. o. b. at the mine in June, about the middle of October was commanding $1.50 and $1.75, an appreciation of fully 100 per cent. Other grades of coal advanced in proportion.

The year, as a whole, from the bituminous standpoint, particularly from the standpoint of western bituminous producers, was unsatisfactory. Many contracts were taken during the summer at prices actually below the cost of production, while on other contract business the operators about broke even as to prices realized, so that profits were eliminated. The seat of the trouble quite naturally is the overproduction which exists in practically every bituminous field tributary to Chicago. Many mines have been opened within the past three years, increasing the tonnage capacity of the bituminous-producing belt to a point beyond what consumption can absorb. As there continues a tendency to open new mines in this great territory, the prospects for the present year are not the most encouraging, although a suspension of mining operations for two or three months might work a change which in the end would be beneficial.

Receipts of anthracite coal at Chicago, Ill., by lake and rail.

[Short tons.]

Month.	Anthracite by lake.		Anthracite by rail.		Total anthracite.		Increase or decrease in 1905.
	1904.	1905.	1904.	1905.	1904.	1905.	
January			53,889	68,244	53,889	68,244	+14,355
February			62,038	59,389	62,038	59,389	− 2,649
March			101,113	124,741	101,113	124,741	+23,628
April		59,802	85,246	66,068	85,246	125,870	+40,624
May	4,814	89,931	93,586	72,415	98,400	162,346	+63,946
June	142,688	86,129	93,147	52,041	235,835	138,170	−97,665
July	147,382	113,855	58,942	48,284	206,324	162,139	−44,185
August	175,557	155,623	63,285	68,042	238,842	223,665	−15,177
September	124,146	154,601	56,599	40,667	180,745	195,268	+14,523
October	145,480	76,818	69,807	58,016	215,287	134,834	−80,453
November	152,943	102,854	72,912	77,900	225,855	180,754	−45,101
December	67,620	118,412	71,674	97,769	139,294	216,181	+76,887
Total	960,630	958,025	882,238	833,576	1,842,868	1,791,601	[a]−51,267

[a] Net decrease.

The receipts of bituminous coal and coke during the last five years have been as follows:

Receipts of bituminous coal and coke at Chicago, Ill., for five years, 1901–1905.

[Short tons.]

State from which received.	1901.	1902.	1903.	1904.	1905.	Increase or decrease in 1905.
Pennsylvania	525,571	487,134	617,521	516,362	707,846	+191,484
Ohio	492,701	616,335	666,265	566,076	631,634	+ 65,558
West Virginia and Kentucky.	1,024,979	969,132	908,154	960,079	968,137	+ 8,058
Illinois	2,427,092	2,958,493	4,301,803	4,094,594	3,894,986	−199,608
Indiana	2,165,549	2,403,519	2,610,716	2,713,597	2,744,405	+ 30,808
By lake	51,240	63,106	85,164	64,688	79,072	+ 14,394
Total bituminous coal	6,687,132	7,497,719	9,189,623	8,915,396	9,026,080	+110,684
Coke	594,686	602,740	591,125	369,731	462,734	+ 93,003

The total receipts and shipments of coal and coke at Chicago during the last five years were as follows:

Receipts and shipments of coal and coke at Chicago, Ill., 1901–1905.

[Short tons.]

Year.	Anthracite.		Bituminous.		Coke.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
1901	2,192,545	514,639	6,687,132	1,239,264	594,686	397,665
1902	674,908	199,735	7,497,719	1,830,615	602,740	416,178
1903	2,169,399	606,711	9,189,623	2,184,193	591,125	375,942
1904	1,842,868	521,628	8,915,396	2,097,042	369,731	246,504
1905	1,791,601	583,643	9,026,080	2,184,037	462,734	296,091

MILWAUKEE, WIS.

The following review of the coal trade of Milwaukee has been contributed by Mr. William J. Langson, secretary of the chamber of commerce:

The coal trade of Milwaukee continues enlarging from year to year, and the Cream City can now fairly lay claim to be the main distributing point on Lake Michigan of the products of the coal mines of Ohio and Pennsylvania. The amount of coal received from lower lake ports at Milwaukee in 1905 was 2,835,132 short tons and by car ferries from Michigan ports 241,606 tons. Including the all-rail receipts, the total amount of coal received at Milwaukee during the year was 3,157,464 short tons, of which 1,268,150 tons were shipped westward by rail and 9,460 tons by lake to other ports.

The annual receipts of coal as given in one of the accompanying tables well illustrates the growth of the coal trade of Milwaukee. This table shows that in 1865 the total supply of coal at Milwaukee from all sources consisted of 36,389 tons, against 3,157,464 tons in 1905.

Deducting the shipments from the total receipts of the past year will show the approximate consumption of coal at Milwaukee in that period to have been 1,879,854 tons. The receipts and shipments of the past year were the largest recorded in the history of the coal trade of Milwaukee.

Receipts of coal at Milwaukee, Wis., for five years, 1901–1905.

[Short tons.]

Source.	1901.	1902.	1903.	1904.	1905.
By lake from—					
Buffalo	717,356	132,803	914,901	809,471	800,814
Erie	259,841	141,130	153,325	91,310	60,641
Oswego	2,365	....	7,003	22,000	4,369
Cleveland	191,785	354,485	436,834	341,658	247,878
Ashtabula	92,698	97,378	230,726	187,772	245,455
Lorain	67,214	69,132	104,549	194,361	159,788
Sandusky	85,488	131,285	213,124	254,014	359,427
Toledo	315,036	416,057	477,950	689,641	770,962
Fairport	4,320	20,690	65,981	22,800	23,051
Ogdensburg	1,368	4,083	....	3,972	....
Huron, Ohio	13,950	2,528	23,046	38,012	87,008
Other ports	13,600	4,400	21,912	41,323	75,739
Total, lake	1,765 021	1,373,971	2,649,351	2,696,334	2,835,132
By railroad	188,468	267,124	374,626	248,105	[a] 322,332
Receipts	1,953,489	1,641,095	3,023,977	2,944,439	3,157,464

[a] Including 241,606 tons by car ferry lines.

Shipments of coal from Milwaukee, Wis., for five years, 1901–1905.

[Short tons.]

Shipped by—	1901.	1902.	1903.	1904.	1905.
Chicago, Milwaukee and St. Paul Rwy	459,252	376,710	350,505	569,330	668,509
Chicago and Northwestern Rwy	255,948	243,535	259,941	361,824	512,536
Wisconsin Central R. R.	56,834	28,823	33,339	55,368	87,105
Lake	4,616	180	6,645	6,040	9,460
Total	776,650	649,248	650,430	992,562	1,277,610

Total receipts of coal by lake at Milwaukee, Wis., for five years, 1901–1905.

[Short tons.]

Kind.	1901.	1902.	1903.	1904.	1905.
Anthracite	845,687	[a] 172,676	946,596	876,169	802,083
Bituminous	1,107,802	1,468,419	1,702,755	1,820,165	2,033,049
Total	1,953,489	1,641,095	2,649,351	2,696,334	2,835,132

[a] Strike.

Receipts of coal at Milwaukee, Wis., by lake and rail in 1865, 1870, 1880, 1890, and annually from 1900 to 1905.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1865	36,369	1901	1,953,489
1870	122,865	1902	1,641,095
1880	368,568	1903	3,023,977
1890	999,657	1904	2,944,439
1900	1,808,593	1905	3,157,464

CINCINNATI, OHIO.

Mr. Charles B. Murray, superintendent of the Cincinnati chamber of commerce, has furnished the following review of the coal trade of that city in advance of the publication of his report:

The quantity of coal received at Cincinnati in 1905 was largely in excess of the high record of the preceding year. This result was partly due to river conditions, the period of navigation covering an unusual proportion of the year. While much the larger gain in arrivals is shown in the exhibit of river receipts for the year, there is also a decided increase shown in rail receipts. Applying percentage in the comparison with the preceding year, there is shown a gain of 66 per cent for river receipts and 18 per cent for rail receipts, the aggregate increase being 36 per cent. It should be remarked that the river receipts of coal in the preceding year were unusually small, the low stage of the river during the last half of the year preventing the movement.

The total receipts of coal at Cincinnati in 1905, as indicated by records and investigations of the chamber of commerce, were 160,820,000 bushels. This compares with 118,184,000 bushels for 1904, and an annual average of 99,975,000 bushels for 5 years prior to 1905. The receipts by river were 72,935,000 bushels, compared with 43,818,000 bushels for 1904 and an annual average of 50,993,000 bushels for 5 years. Rail receipts were 87,885,000 bushels, compared with 74,366,000 bushels for 1904 and an annual average of 48,982,000 bushels for 5 years.

Coal shipments by river in 1905 were 6,433,000 bushels and by rail 57,541,000 bushels, making a total of 63,974,000 bushels, which compares with a total of 44,676,000 bushels for 1904 and an annual average of 32,517,000 bushels for 5 years.

The receipts of coal in 1905 represented 45 per cent by river and 55 per cent by rail. For a period of 5 years previously river receipts represented 51 per cent and rail receipts 49 per cent.

Prices of lump coal were 8 cents per bushel for lots afloat for Pittsburg district product, throughout the year, and 7½ to 8 cents for Kanawha, mainly 8 cents, so that 8 cents may be regarded as the year's position. Run-of-mine Pittsburg coal was quoted at 7¼ cents, and nut and slack 5 to 5½ cents. Kanawha nut and slack was quoted mostly at 4½ to 5 cents per bushel. The price of lump coal delivered to consumers, for both Pittsburg (Youghiogheny) and Kanawha, was $3.50 per ton for about 5 months of the year and $3.25 for 7 months. The general average price for the year was $3.35 per ton, compared with $3.20 for 1904, and an annual average of $3 for 5 years. The general average price for the year for lump coal afloat was about 8 cents per bushel, compared with 8.50 cents for 1904, and an annual average of 8.15 cents for 5 years. For nut and slack coal some sales of Kanawha were made at $1.75 per ton, delivered, but the prevailing price was $1.90, and for Pittsburg $2—general average about $1.95 per ton.

Anthracite coal for lots delivered to consumers sold at $7.50 per ton until April, declined to $7.25, and advanced to $7.50 in October, averaging $7.37 for the year, compared with $7.30 for 1904, and an annual average of $7.60 for 5 years.

The consumption of coal, as near as can be estimated upon statements of dealers, has been pretty evenly divided between industrial and household requirements, the past year seeming to justify about 55 per cent as the proportion for industrial uses and 45 per cent for household purposes.

The yearly range and average prices of Pittsburg coal, afloat and delivered, per bushel, based on weekly records, compare for a series of years as shown in the following compilation:

Prices of Pittsburg coal at Cincinnati, 1901–1905.

[Cents per bushel.]

Year.	Afloat.			Delivered.		
	Lowest.	Highest.	Average.	Lowest.	Highest.	Average.
1901	6½	8	7.50	9	10¾	10.55
1902	6½	10	7.92	10	14½	11.75
1903	9	10	9.25	12⅝	14½	13.18
1904	8	9	8.50	10¾	13½	11.50
1905	8	8	8.00	11¾	12⅝	12.05

Coal from the Kanawha, Virginia, and West Virginia regions sells at the same, or about the same, prices as are obtained for the product from the Pittsburg district. Sales afloat are on the bushel basis, 72 pounds; sales delivered are on the ton basis, 2,000 pounds, and represent screened or lump grade.

The receipts of coke for the year were 4,580,000 bushels, and the quantity locally manufactured was 7,219,000 bushels, making a total of 11,799,000 bushels, compared with 10,934,000 bushels the preceding year. For city manufacture the average price for the year was 10½ cents per bushel; of gas house, 9 cents; of Connellsville, $6.50 per ton.

A summary of the movement of coal at Cincinnati, in bushels, during the last two years, and the total receipts, in short tons, since 1901, are shown in the following tables:

Summary of coal movements at Cincinnati, Ohio, in 1904 and 1905.

[Bushels.]

Details.	1904.	1905.	Details.	1904.	1905.
Total received	118,183,783	160,820,000	Anthracite	748,000	545,000
Pittsburg	22,528,563	40,689,000	Total:		
Ohio River	130,707	310,000	By river	43,817,783	72,935,000
Kanawha:			By rail	74,366,000	87,885,000
By river	21,158,513	31,936,000	Shipped:		
By rail	40,490,000	48,037,000	By river	3,448,000	6,433,000
Total Kanawha	61,648,513	79,973,000	By rail	41,228,000	57,541,000
Other kinds by rail	33,128,000	39,303,000	Total shipped	44,676,000	63,974,000

Total annual receipts of coal at Cincinnati.

Year.	Short tons.	Year.	Short tons.
1901	3,292,604	1904	4,257,613
1902	3,766,796	1905	5,791,000
1903	4,046,710		

NOTE.—Kanawha receipts of coal by rail are computed by percentage of total receipts by rail, based on best available information.

Receipts of coke in 1905, 4,580,000 bushels; locally manufactured, 7,219,000 bushels; shipments, 6,920,000 bushels.

ST. LOUIS, MO.

The following summary of the coal trade of St. Louis for 1905 has been prepared for this report by Mr. William Flewellyn Saunders, secretary and general manager of the Business Men's League of that city:

The prices of coal and coke at St. Louis during 1905 vary only a little from the prices of 1904, the slight fluctuations being due entirely to temporary local conditions. The natural growth of the city in population and in the number of factories and their output increased the consumption, of course, for both hard and soft coal and for coke.

There is not likely to be any change in the St. Louis soft coal field, and the bulk of the supply will continue to come from the Illinois mines. They are nearer the city than any satisfactory coal produced in Missouri or Arkansas and the coal is, therefore, cheaper.

A special feature of the fuel situation during the year has been the large increase in the use of gas for cooking and in the use of electricity for power by large mercantile concerns and factories, this gas and electricity both being supplied by one large central plant. The plan of converting coal into electricity at the mines and conducting it to the city is being discussed, but is not regarded now as commercially feasible, although it is worth considering as one of the sources of cheap power for the future.

The coal-testing plant of the United States Geological Survey at St. Louis attracts large numbers of power users to the city and is teaching them much on the economy of fuel consumption.

Coal prices at St. Louis, Mo., during 1904 and 1905.

Kind.	1904.			1905.		
	Highest.	Lowest.	Closing.	Highest.	Lowest.	Closing.
Standard Illinois lump coal	\$2.05	\$1.45	\$1.50	\$2.00	\$1.52½	\$1.55
High-grade Illinois lump coal	2.80	1.90	2.55	2.55	1.80	2.30
Anthracite, large	7.15	6.65	7.15	7.15	6.65	7.15
Anthracite, small	7.40	7.15	7.40	7.40	6.90	7.40
Connellsville coke	5.30	5.10	5.30	6.80	5.45	6.80
New River coke	5.30	5.10	5.30	6.00	5.25	6.00
Kentucky coke	3.80	3.60	3.80	3.50	5.45	3.50
Gas coke	5.50	4.20	5.50	5.50	4.20	5.50

Coal and coke receipts at St. Louis, Mo., 1901–1905.

Year.	Soft coal.	Hard coal.	Coke.	Year.	Soft coal.	Hard coal.	Coke.
	Bushels.	*Tons.*	*Bushels.*		*Bushels.*	*Tons.*	*Bushels.*
1901	118,860,775	200,797	11,746,592	1904	170,970,875	155,097	8,558,100
1902	130,145,350	60,944	8,180,000	1905	171,727,675	158,843	12,350,278
1903	159,221,625	165,920	11,414,720				

PRODUCTION OF COAL, BY STATES.

Including Alaska, Idaho, and Nevada, in each of which a few hundred tons of coal were produced, there were 31 States and Territories which contributed to the total production in 1905. Of these 31 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 1905, 347,220,189 short tons, or 88.3 per cent of the total product, while the 18 States west of the river produced 45,699,152 short tons, or 11.7 per cent of the total. Of the 13 States east of the Mississippi River 6 are located north of the natural dividing line formed by the Ohio and Potomac rivers, and 7 lie to the south of the line. The 6 northern States produced in 1905, 278,537,802 short tons, while the 7 southern States produced 68,682,387 short tons. But while the northern States excel the southern ones to such a great extent the ratio of increase during the last 25 years has been decidedly in favor of the latter. In 1880 the northern States produced 63,044,558 short tons and the southern States 3,793,308, the former being about seventeen times the latter. In 1905 the northern States produced 278,537,802 short tons, or a little over four times the 68,682,387 tons produced in the southern States in that year. The production of the northern States in 1905 was 4.4 times what it was in 1880, while that of the southern States was eighteen times as large. The States west of the Mississippi River have increased their coal production from 4,624,324 short tons in 1880 to 45,699,152 tons in 1905, the output in the latter year being a little less than ten times that of 1880.

In the following tables the production of the different States grouped according to the geographical divisions made by the Mississippi, Ohio, and Potomac rivers is given for the years 1880, 1890, 1900, 1904, and 1905, in order that the development in the different sections may be observed:

Coal production in States north of Ohio and Potomac rivers in 1880, 1890, 1900, 1904, and 1905.

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.	1904.		1905.	
	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*	
Illinois	36,475,060	$39,941,993	38,434,363	$40,577,592
Indiana	10,842,189	12,004,300	11,895,252	12,492.255
Maryland	4,813,622	5,729,085	5,108,539	5,831,760
Michigan	1,342,840	2,424,935	1,473,211	2,512,697
Ohio	24,400,220	26,579,738	25,552,950	26,486,740
Pennsylvania:				
Anthracite	73,156,709	138,974,020	77,659,850	141,879,000
Bituminous	97,938,287	94,428,219	118,413,637	113,390,507
Total	248,968,927	320,082,290	278,537,802	343,150,551

Coal production in States south of Ohio and Potomac rivers in 1880, 1890, 1900, 1904, and 1905.

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.	1904.		1905.	
	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*	
Alabama	11,262,046	$13,480,111	11,866,069	$14,387,721
Georgia	383,191	466,496	351,991	453,848
Kentucky	7,576,482	7,868,192	8,432,523	8,385,232
North Carolina	7,000	10,500	1,557	2,336
Tennessee	4,782,211	5,642,393	5,963,396	6,797,550
Virginia	3,410,914	2,921,911	4,275,271	3,777,325
West Virginia	32,406,752	28,647,014	37,791,580	32,341,790
Total	59,828,596	59,036,617	68,682,387	66,145,802

Coal production in States west of Mississippi River in 1880, 1890, 1900, 1904, and 1905.

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

Coal production in States west of Mississippi River in 1880, etc.—Continued.

State or Territory.	1904.		1905.	
	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*	
Arkansas	2,009,451	$3,102,660	1,934,673	$2,880,738
California	[a] 79,582	[a] 377,306	[a] 80,824	[a] 395,975
Colorado	6,658,355	8,751,821	8,826,429	10,810,978
Idaho	[b] 3,480	[b] 13,730	[b] 5,882	[b] 17,846
Indian Territory	3,046,539	5,532,066	2,924,427	5,145,358
Iowa	6,519,933	10,504,406	6,798,609	10,586,381
Kansas	6,333,307	9,640,771	6,423,979	9,350,542
Missouri	4,168,308	6,801,751	3,983,378	6,291,661
Montana	1,358,919	2,194,548	1,643,832	2,823,350
Nebraska				
New Mexico	1,452,325	1,904,499	1,649,933	2,190,231
North Dakota	271,928	389,052	317,542	424,778
Oregon	111,540	243,588	109,641	282,495
Texas	1,195,944	1,983,636	1,200,684	1,968,558
Utah	1,493,027	1,943,440	1,332,372	1,793,510
Washington	3,137,681	5,120,931	2,864,926	5,141,258
Wyoming	5,178,556	6,747,909	5,602,021	7,336,951
Total	43,018,875	65,252,114	45,699,152	67,440,610

[a] Includes Alaska. [b] Includes Nevada.

The production of coal in the several States and Territories in 1905 and preceding years is discussed more in detail in the following pages.

ALABAMA.

Total production in 1905, 11,866,069 short tons; spot value, $14,387,721.

Notwithstanding the fact that the strike against the Tennessee Coal, Iron and Railroad Company, the Tutwiler Coal, Coke and Iron Company, and the Sloss-Sheffield Steel and Iron Company, which was inaugurated in July, 1904, and which caused a decrease in the coal production for that year, was still officially "on" throughout the entire year of 1905, the total production for the State reached the highest figure in its history. The mines of the three companies affected by the strike were operated "open-shop," and while in the case of some of the Sloss-Sheffield properties the company was compelled to work with a reduced force, with a consequently decreased output, the Pratt mines of the Tennessee Company were operated with an increased but less efficient force and yielded an average production. The total production of the State during 1905 amounted to 11,866,069 short tons, valued at $14,387,721, an increase in tonnage of 604,023, or 5.3 per cent, and a gain in value of $907,610, or 6.7 per cent, over 1904. Compared with 1903, the year of previous largest production, the output in 1905 shows an increase of 211,745 short tons in amount and of $140,923 in value. The average price per ton in 1905 was $1.21, as compared with $1.20 in 1904 and $1.22 in 1903.

The returns to the Geological Survey for 1905 show that there were 19,595 men employed for an average of 225 days. Considering these figures with the total production, it is found that the average output per man was 605.6 tons for the year, and as the average working time was 225 days the average number of tons produced per day per man was 2.69 tons, as compared with a daily output of 2.93 tons per man in

1904, when 17,811 men worked an average of 216 days and produced 11,262,046 tons of coal. The yearly tonnage per man in 1904 was 632.3 tons, or 26.7 tons more than in 1905.

One of the notable features in connection with the production of coal in Alabama during 1905 was the large increase in the number of mining machines and in the amount of machine-mined coal produced. According to the reports to the Survey there were 213 machines in use in 1905 against 141 in 1904, while the amount of coal undercut by machines increased from 577,317 short tons in 1903 to 741,170 tons in 1904, and 1,584,942 short tons in 1905, the machine tonnage in the later year being a little more than double that of 1904 and nearly three times that of 1903. In addition to the 213 machines reported as in use, there were 37 others installed in the latter part of the year which were not used. Of the total number of machines in use in 1905, 171 were of the pick or puncher type and 42 were chain machines.

Most of the larger mines in Alabama are operated on a 10-hour day, 62 operations employing 19,809 men, or considerably more than half the total number, having reported 10 hours as the length of the working day; 30 mines, employing 3,320 men, worked 9 hours, and 24, employing 1,069 men, worked 8 hours. Three mines worked 9½ hours, and 2 worked 8½ hours.

The increased number of accidents in the coal mines of Alabama as reported by the State inspector of mines, Mr. J. M. Gray, is a record greatly to be deplored. These statistics are not collected by the Geological Survey.[a] According to Mr. Gray's report the number of fatalities in 1905 was 185, against 84 in 1904, 57 in 1903, 50 in 1902, 41 in 1901, and 37 in 1900. Taking these figures in connection with the production and the number of employees in each year as reported to the Survey, it is found that the number of tons produced for each life lost was 226,872 in 1900; 221,928 in 1901; 206,081 in 1902; 204,462 in 1903; 134,072 in 1904, and 64,141 in 1905, while for each 1,000 employees the fatalities were 2.6 in 1900; 2.4 in 1901; 3 in 1902; 2.7 in 1903; 4.7 in 1904, and 9.44 in 1905. The large increase in fatal accidents in 1905 was due to an explosion in the Virginia mine of the Southern Steel Company, in which 112 men were killed. Except for this, the record for 1905 would have been better than that for 1904. The explosion at the Virginia mine occurred on February 20, at 4 o'clock in the afternoon, the regular shooting time. A commission, consisting of the three mine inspectors, two miners, and a third party, investigated the explosion and reported that it was, in its opinion, a dust explosion, caused by a "windy," or "blown-out" shot.

The total number of men reported on strike in the mines of Alabama in 1905 was 667. Of these, 75 were at the mines of the Tutwiler Coal, Coke and Iron Company, but operations continued steadily throughout the year. The total time lost by strikes was 33,262 working days, or an average of about 50 days for each man on strike.

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[a] Mr. Gray's report for 1905 gives a total production for the State of 11,900,153 short tons, about 34,000 tons more than the tonnage reported to the Survey. Mr. Gray's report, however, includes an estimated output of 108,000 tons for small mines and mines not reported. The Survey figures embrace only the tonnage actually reported direct, or in a few cases, obtained from Mr. Gray.

The statistics of production in Alabama in 1904 and 1905, with the distribution of the product for consumption, are shown in the following tables:

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.

Coal production of Alabama in 1905, 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	1,263,741	3,569	68,613	....	1,335,923	$1,794,484	$1.34	240	1,965
Etowah	165,369	4,321	794	....	170,484	211,596	1.24	213	284
Jefferson	3,069,930	301,527	192,738	2,309,073	5,873,268	7,055,928	1.20	231	9,644
St. Clair	177,436	977	8,182	....	186,595	235,288	1.26	175	398
Shelby	147,617	1,180	8,772	....	157,569	270,044	1.71	224	260
Tuscaloosa	293,108	42,519	19,867	529,867	885,361	1,123,355	1.27	207	1,392
Walker	2,549,899	12,495	44,626	238,597	2,845,617	3,230,105	1.14	212	4,666
Winston	38,540	1,569	....	....	40,109	62,233	1.55	161	145
Other counties [a]	297,413	10,693	7,280	54,397	369,783	402,968	....	....	841
Small mines	....	1,360	....	....	1,360	1,720	1.93	....	....
Total	8,003,053	380,210	350,872	3,131,934	11,866,069	14,387,721	1.21	225	19,595

[a] Blount, Cullman, Dekalb, Jackson, and Marion.

In the following table is presented a statement of the production of coal in Alabama, by counties, during the last five years, with the increases and decreases in 1905 as compared with 1904:

Coal production of Alabama, 1901–1905, by counties.

[Short tons.]

County.	1901.	1902.	1903.	1904.	1905.	Increase or decrease in 1905.
Bibb	1,258,853	1,487,407	1,651,157	1,386,079	1,335,923	− 50,156
Blount, Cullman	143,697	[a]253,178	[a]260,802	[a]279,070	[a]294,550	+ 15,480
Etowah	93,591	101,790	119,830	128,989	170,484	+ 41,495
Jefferson	5,549,715	5,855,536	6,194,832	5,821,663	5,873,268	+ 51,605
St. Clair	140,816	156,243	152,313	144,223	186,595	+ 42,372
Shelby	149,132	136,043	240,962	128,307	157,569	+ 29,262
Tuscaloosa	374,718	431,711	610,392	663,412	885,361	+221,949
Walker	1,284,025	1,903,976	2,365,385	2,583,473	2,845,617	+262,144
Winston	69,505	28,686	50,841	40,356	40,109	− 247
Other counties and small mines	35,000	([b])	7,810	[c]86,474	76,593	− 9,881
Total	9,099,052	10,354,570	11,654,324	11,262,046	11,866,069	+604,023
Total value	$10,000,892	$12,419,666	$14,246,798	$13,480,111	$14,387,721	$+907,610

[a] Includes production of Marion County. [b] Small-mine production included in county distribution. [c] Includes Dekalb and Jackson counties.

The Alabama coal fields form the southwestern end of the great Appalachian coal field, which extends from northern Pennsylvania to central Alabama. The coal-bearing formations narrow in Tennessee but widen abruptly in northern Alabama and cover about 6,000 square miles in the northern half of the State. There are four distinct coal-producing basins or districts in the State—the Coosa, Cahaba, and Warrior basins, and the Plateau regions. The first three mentioned areas derive their names from the rivers which drain them.

The Coosa basin is a deep syncline forming the southeast margin of the Alabama coal fields, extending across Shelby and St. Clair counties. It is 60 miles long by 6 miles wide and contains about 350 square miles. This basin has not been thoroughly explored, and the number and extent of its coal beds are not well known, but in different parts 2 to 12 seams 3 feet and over thick are reported. In 1905 6 mines working 4 different seams were in operation in the northern end of the basin in St. Clair County. Their total output was 186,595 tons.

The Cahaba basin is also a syncline west of the Coosa basin to which it is parallel, and from which it is separated by a faulted anticlinal valley. It includes parts of St. Clair, Jefferson, Shelby, and Bibb counties. Its length is 68 miles, its average width about 6 miles, and its area 394 square miles. There are many workable seams and the total coal in the basin is great. In 1905 there were 24 mines in operation supposed to be working 11 different seams. Except the one mine which is in Jefferson County, these are all in the south end of the basin in Shelby and Bibb counties. Their combined production was 1,547,784 tons.

The Warrior basin is separated from the Cahaba basin and Blount Mountain by Jones and Murphrees valleys. It includes all of Walker County, most of Jefferson, Tuscaloosa, and Fayette counties, and smaller parts of Blount, Cullman, Winston, and Marion counties. Its known area is estimated at 3,000 square miles. Around its western and southern margin, however, its higher rocks and coal seams pass under rocks of much later age and probably have a considerable and may have a great extent to the southwest of their visible margin. This basin has always been the scene of the greatest mining activity and production in the State. In 1905 the 148 mines operating in the basin produced 9,791,356 tons of coal. Of this amount about 3,400,000 tons were produced from the Pratt seam and about 2,375,202 tons from the Mary Lee seam. The remaining production mostly comes from 8 to 10 other seams.

The Plateau regions include Blount, Lookout, and Sand or Raccoon mountains. The coal-bearing rocks embrace parts of Blount, Etowah, Dekalb, Cherokee, Marshall, and Jackson counties, and are upward of 2,000 square miles in extent. The Plateau regions and the Warrior basin are the southwest extension of the Cumberland Plateau in Tennessee. The coal resources of the Plateau regions are not well known, but they are comparatively small. There are believed to be from 4 to 6 seams that are locally workable. In 1905, 11 mines were in operation in the regions and produced 361,758 tons of coal.

So far as known the earliest record of the existence of coal in Alabama was made in 1834. The first statement of production in the State is contained in the United States Census Report for 1840, in which year the production is given as 946 tons. The Census report for 1850 does not mention any coal production for the State, and the next authentic record is contained in the Census statistics of 1860, when Alabama is credited with an output of 10,200 short tons. The mines of Alabama were probably worked to a considerable extent during the civil war, but there are no records of the actual production until 1870, for which year the United States Census reports a production of 11,000 tons. Ten years later the production had increased to 323,972 short tons, but the development of the present great industry really began in 1881 and 1882, when the large iron deposits near the city of Birmingham were discovered and inaugurated the great "boom" of that city and vicinity. By 1885 the coal production of the State had increased to nearly 2,500,000 tons. Then followed a period of relapse and liquidation which lasted for two years, after which business settled down to a conservative and rational basis and has since developed steadily. In 1902 the coal production of the State reached a total of over 10,000,000 tons, and has exceeded 11,000,000 tons in each of the last three years.

The record from 1840 to the close of 1905 is shown in the following table, the production in the years for which no official statistics are available having been estimated by the writer.

Annual coal production of Alabama, 1840–1905.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Short tons.		*Short tons.*		*Short tons.*
1840 [a]	946	1862	12,500	1884	2,240,000
1841	1,000	1863	15,000	1885	2,492,000
1842	1,000	1864	15,000	1886	1,800,000
1843	1,200	1865	12,000	1887	1,950,000
1844	1,200	1866	12,000	1888	2,900,000
1845	1,500	1867	10,000	1889	3,572,983
1846	1,500	1868	10,000	1890	4,090,409
1847	2,000	1869	10,000	1891	4,759,781
1848	2,000	1870 [a]	11,000	1892	5,529,312
1849	2,500	1871	15,000	1893	5,136,935
1850	2,500	1872	16,800	1894	4,397,178
1851	3,000	1873	44,800	1895	5,693,775
1852	3,000	1874	50,400	1896	5,748,697
1853	4,000	1875	67,200	1897	5,893,770
1854	4,500	1876	112,000	1898	6,535,283
1855	6,000	1877	196,000	1899	7,593,416
1856	6,800	1878	224,000	1900	8,394,275
1857	8,000	1879	280,000	1901	9,099,052
1858	8,500	1880 [a]	323,972	1902	10,354,570
1859	9,000	1881	420,000	1903	11,654,324
1860 [a]	10,200	1882	896,000	1904	11,262,046
1861	10,000	1883	1,568,000	1905	11,866,069

[a] United States census fiscal year.

RESULTS OF TESTS OF ALABAMA COALS.

The more important features of the results of tests made on Alabama coals at the Geological Survey coal-testing plant[a] at St. Louis, Mo., are briefly summarized below. For more detailed reports see Professional Paper No. 48, and Bulletin No. 290, of the United States Geological Survey.

Alabama No. 1.—Operator, Ivy Coal and Iron Company. Mine, No. 8, 1½ miles west of Horse Creek, Walker County. Seam, Horse Creek. Kind of coal, bituminous; over 1-inch screen.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	1.22	1.35	2.34
	Volatile matter	31.53	31.67	31.84
	Fixed carbon	54.44	53.35	53.28
	Ash	12.81	13.63	12.54
Ultimate.	Sulphur	.71	.71	.72
	Hydrogen			5.01
	Carbon			71.58
	Nitrogen			1.65
	Oxygen			8.50
Calorific value determined:				
	Calories		7,217	7,142
	British thermal units		12,991	12,856

Boiler test: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 8.44 pounds; dry coal consumed per electrical horsepower per hour 4.14 pounds.

No producer-gas test was made on this coal.

Coking test: Crushed to 1½ inches, both washed and unwashed, coal gave light, spongy coke, high in ash.

Washing test: Washing coal did not materially improve quality of coke.

Briquetting test: Readily made into briquets with hard pitch, and under very heavy pressure can be briquetted without any binder.

Alabama No. 2.—Operator, Galloway Coal Company. Mine, No. 5, about ¾ mile northwest of Carbon Hill, Walker County. Seam, Jagger. Kind of coal, bituminous; through 8-inch and over ¾-inch screen, also washed slack.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	2.25	2.42	3.36
	Volatile matter	35.70	34.83	32.86
	Fixed carbon	53.01	51.62	51.33
	Ash	9.04	11.13	12.43
Ultimate.	Sulphur	1.09	1.10	1.01
	Hydrogen			4.84
	Carbon			68.69
	Nitrogen			1.54
	Oxygen			11.49
Calorific value determined:				
	Calories	7,296	7,053	6,861
	British thermal units	13,133	12,695	12,350

Boiler test: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 8.81 pounds; dry coal consumed per electrical horsepower per hour 3.96 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour 1.64 pounds.

Coking test: Coked imperfectly in small pieces, very soft, and mixed with charred coal and ash; by proper washing may yield fair coke.

[a] For brief description of the equipment used in these tests see page 6.

ALASKA.

The returns from the coal producers in Alaska in 1905 were more complete than in the two preceding years, the total production reported to the Survey for 1905 being 3,774 short tons, as compared with 694 short tons in 1904 and 747 tons in 1903. In 1902, when more complete statistics were obtained than in 1903 and 1904, the output reported was 2,212 short tons, and Mr. G. C. Martin, of the geologic branch of the Survey, who has been working in Alaska, states that the total production in 1903 and 1904 was at least 2,000 tons and was probably between 2,500 and 3,000 tons.

Considering the quantity of fuel consumed in Alaska and by the steamers plying between the ports of the Pacific States and the Territory, the tardy development of what are known to be excellent coal beds in Alaska is somewhat remarkable. The following notes on the coal trade of Alaska and on the known coal fields of the Territory have been prepared by Mr. Martin for this report.

The quantity of coal shipped to Alaska during recent years is shown in the following table.[a]

Shipments of coal to Alaska, 1903–1905.

	12 months ending June 30, 1903.		12 months ending June 30, 1904.		12 months ending June 30, 1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
Domestic anthracite	22	$276			6	$85
Domestic bituminous	62,854	255,841	46,709	$193,740	47,314	187,352
Domestic coke	73	288	439	2,251	535	4,281
Canadian bituminous	60,561	216,089	71,290	261,987	77,840	[a]286,000
Australian bituminous			1,802	4,303		
Foreign bituminous shipped via United States	45	350	3,723	23,904	6,216	29,673
Total	123,555	472,844	123,963	486,185	131,911	507,391

[a] Estimated.

The production in the Territory, as reported to the Survey since 1899, has been as follows:

Production of coal in Alaska since 1899.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1899	1,200	$16,800	1903	747	$6,582
1900	1,200	16,800	1904	694	1,725
1901	1,300	15,600	1905	3,774	13,250
1902	2,212	19,048			

The remainder of the Alaska fuel supply consisted in 1905 of 64,652 barrels of crude petroleum shipped from California and used largely under boilers, especially on the Yukon steamers and in placer camps; 704,226 gallons of naphtha, used chiefly for power, and a large but unknown amount of wood.

[a] Commerce of the noncontiguous territory of the United States, Bureau of Statistics, 1903, 1904, 1905. The long ton unit used by the Bureau has been reduced to short tons, the standard for this report.

It may be confidently expected that the coal production of Alaska will increase to a considerable amount in the next few years.[a] This will be brought about by the increase in population, new industries, and railroads, and by some of the better grades of coal being made accessible by the construction of railroads. It seems probable that Alaska coal will not only supply a large proportion of the local consumption, but that it will be used as bunker coal by most of the Alaska steamers, and will be shipped to the Pacific coast States and possibly to more distant markets on the Pacific Ocean.

Coal fields of Alaska.—The following districts may possibly develop important coal mines in the next few years: Bering River, Matanuska River, Cook Inlet, Alaska Peninsula and vicinity, Yukon and Tanana valleys, Seward Peninsula, and Cape Lisburne.

The Bering River coal field[b] covers about 75 square miles of coal-bearing rocks, of which about 25 square miles is underlain by anthracite and 50 square miles by semianthracite and semibituminous coal. The former will yield a good grade of domestic fuel, while the latter is well adapted for use as high-grade steam fuel and also for cokemaking.

The Matanuska coal field[c] includes anthracite, semibituminous coal, and a lower grade which may be classed as subbituminous or black lignite. The anthracite is possibly limited in area but is of good quality. The best of the semibituminous coal is not unlike some of the Bering River semibituminous. Most of the seams are neither as pure nor as thick as many of those in the Bering River region, but they can probably be mined more cheaply and will possibly yield a better quality of coke. The subbituminous coal from the western end of the Matanuska field is much like some of the Puget Sound coal. Neither Bering River nor Matanuska River coal is now available, but it seems probable that shipping facilities will soon be provided for both.

The Cook Inlet coal fields[d] have a large but unestimated area and contain black and brown lignite (or perhaps more definitely designated as subbituminous coal and lignite), the former of good quality. They are being worked to a limited extent for local use.

The Alaska Peninsula and adjoining islands contain many scattered areas from Amalik Bay on the east to the vicinity of the Shumagin Islands on the west. The coal ranges from a fair grade of subbituminous to lignite. It is mined in a small way at Chignik and at Coal Harbor.

ARKANSAS.

Total production in 1905, 1,934,673 short tons; spot value, $2,880,738.

Conditions affecting the coal-mining industry of Arkansas have been far from satisfactory during the last 2 years, and this State is one of the few in which the production has twice declined. During 1905 the production of coal in both Arkansas and the Indian Territory was seriously affected by the large quantity of cheap fuel oil thrown upon the market as the result of the overproduction of this fuel in Texas. A number of the railroads in Texas adopted oil for locomotive fuel, and this so restricted the markets for Arkansas and Territory coals that a large number of coal cars ordinarily used in these districts were diverted to other points of production. In the latter part of 1905 there was a material decline in the production of Texas oil, and many consumers turned again for supplies of fuel to the coal fields of Arkansas

[a] For more complete discussion of this subject see Markets for Alaska Coal, by G. C. Martin, Bull, U. S. Geol. Survey No. 284, 1906.
[b] Martin, G. C., Bull, U. S. Geol. Survey No. 284, 1906.
[c] Martin, G. C., Bull. U. S. Geol. Survey No. 284, 1906, pp. 88-100; Bull. U. S. Geol. Survey No. 289, 1906.
[d] Stone, R. W., Bull. U. S. Geol. Survey No. 259, 1905, pp. 151-172.

and the Territory. There was consequently an increased demand which could not be immediately met; first, because of the short car supply, and, second, because of a scarcity of labor, the miners and other employees at the coal mines having sought other fields of employment. The increased demand for coal from Texas, as well as the activity created in the latter part of the year by the prospect of a total cessation of work on April 1, 1906, would have brought the production for the year up to that of 1904, and possibly to that of 1903, had it not been for the shortage in labor and car supply. As it was, the output decreased from 2,229,172 short tons in 1903 to 2,009,451 tons in 1904, and to 1,934,673 tons in 1905, while the value of the product declined from $3,360,831 in 1903 to $3,102,660 in 1904, and to $2,880,738 in 1905. The average price per ton obtained in 1905 was $1.49, against $1.54 in 1904.

The statistics as collected by the Survey show that there were employed in the coal mines of Arkansas during 1905 a total of 4,192 men, who worked an average of 177 days, as compared with 4,580 men for 165 days in 1904. The average production per man was 438.7 tons in 1904 and 461.5 in 1905, while the average daily production per man was 2.66 in 1904 and 2.60 in 1905. During the last 3 years and since the mines of Arkansas were unionized, they have been working on the basis of an 8-hour day.

The coal-mining industry in Arkansas was not materially affected by strikes in either 1904 or 1905. In the former year only two mines reported labor troubles and the time lost was insignificant. In 1905 strikes were reported at 8 mines and 625 men were idle for an average of 12 days. In one of these instances the places of the strikers were immediately filled and no time was actually lost. The Consolidated Anthracite Coal Company at Spadra reported several stoppages at various times during the year, but no record was made of the time lost by the men, and the production was not noticeably reduced.

According to Mr. Martin Rafter, State inspector of mines, there were during the fiscal year ending June 30, 1906, 8 men killed and 34 injured. Five wives were made widows and 14 children left fatherless. The death rate per thousand was 1.91, and the number of tons mined for each fatality was 241,834.

There have not been any machines used in the production of coal in Arkansas during the last three years.

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 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

Coal production of Arkansas in 1905, 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	413,384	1,000	6,000	420,384	$585,419	$1.39	202	750
Johnson	204,091	1,771	8,372	214,234	364,390	1.70	164	730
Logan	24,390	800	900	26,090	58,388	2.24	191	104
Pope	33,952	813	4,920	39,685	140,030	3.53	217	140
Sebastian	1,150,856	7,667	30,932	1,189,455	1,668,597	1.40	168	2,389
Scott and Washington	42,500	1,245	1,080	44,825	63,914	1.43	216	79
Total	1,869,173	13,296	52,204	1,934,673	2,880,738	1.49	177	4,192

A statement of the production of coal in Arkansas, by counties, during the last five years, with the increases and decreases in 1905 as compared with 1904, is shown in the following table:

Coal production of Arkansas, 1901–1905, by counties.

[Short tons.]

County.	1901.	1902.	1903.	1904.	1905.	Increase or decrease, 1905.
Franklin	504,946 (Franklin, Johnson, Logan, Pope)	338,013	394,884	408,494	420,384	+11,890
Johnson		193,258	198,999	217,667	214,234	− 3,433
Logan		21,751	27,286	35,300	26,090	− 9,210
Pope		34,966	48,836	51,488	39,685	−11,803
Sebastian	1,305,190	1,325,181	1,528,888	1,234,794	1,189,455	−45,339
Other counties and small mines	6,000	30,763	[a] 30,279	61,708	44,825	−16,883
Total	1,816,136	1,943,932	2,229,172	2,009,451	1,934,673	−74,778
Total value	$2,068,613	$2,539,214	$3,360,831	$3,102,660	$2,880,738	−$221,922

[a] Includes also production of Perry County.

The coal field of Arkansas is located in the west-central portion of the State, in the drainage basin of the Arkansas River, extending eastward from the Arkansas-Indian Territory line, a distance of about 75 miles. The greatest width of the coal-bearing area is about 50 miles, at the western border of the State. The Backbone Ridge, an anticlinal fold, which extends nearly due east from the Territory line a distance of about 15 miles, cuts the coal area almost in two. To the north of this ridge the coal-bearing formation extends along both sides of the Arkansas River, an average width of about 20 miles, to the eastern extremity of the field. Immediately to the south of the ridge the coal beds terminate rather abruptly a short distance from the State line (about 7 miles), except for a long, narrow arm in the Poteau and White Oak mountains, which runs eastwardly about 30 miles, with an average width of about 5 miles. This arm marks the southern limit of the coal field. The coal-bearing formation of the State has been estimated to cover an area of 1,728 square miles; but Mr. Arthur J. Collier, who at the time of the writing of this report is making a survey of the field, states that this estimate is much too large, and that the coal area underlain by coal beds known to be of commercial value at present does not exceed one-third of the region, or, say, 600 square miles. If Mr. Collier is correct, the generally accepted idea as to the extent of the Arkansas coal field has been much exaggerated.

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 locomotives 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.

In addition to the area of true coals, which is all usually considered as constituting the coal field of Arkansas, there are important beds of lignite in the central and southern portions of the State. Owing, however, to the abundance, cheapness, and excellence of the true coals, little attention has been paid to the lignites. A small amount has been produced in Ouachita County, in which, with Union County to the south, the lignite beds have their greatest thickness.

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 20 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 20 years, except the last 2, the production has increased rapidly, there being but three other instances 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, 1840–1905.

[Short tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1840	220	1888	276,871	1898	1,205,479
1860	200	1889	279,584	1899	843,554
1880	14,778	1890	399,888	1900	1,447,945
1881	20,000	1891	542,379	1901	1,816,136
1882	25,000	1892	535,558	1902	1,943,932
1883	50,000	1893	574,763	1903	2,229,172
1884	75,000	1894	512,626	1904	2,009,451
1885	100,000	1895	598,322	1905	1,934,673
1886	125,000	1896	675,374		
1887	129,600	1897	856,190		

RESULTS OF TESTS OF ARKANSAS COALS.

The more important features of the results of tests made on Arkansas coals at the Geological Survey Coal Testing Plant[a] at St. Louis, Mo., are briefly summarized below. For more detailed reports see Professional Paper No. 48 and Bulletin No. 290 of the United States Geological Survey.

[a] For brief description of the equipment used in these tests see page 6.

Arkansas No. 1.—Operator, Central Coal and Coke Company. Mine No. 3, at Huntington, Sebastian County. Seam, Huntington. Kind of coal, bituminous; over $1\frac{1}{8}$-inch screen.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	1.02	0.75	3.24
	Volatile matter	17.88	18.50	17.46
	Fixed carbon	73.61	73.77	66.69
	Ash	7.49	6.98	12.61
Ultimate.	Sulphur	1.10	1.15	1.24
	Hydrogen	....	....	4.15
	Carbon	....	....	74.09
	Nitrogen	....	....	1.44
	Oxygen	....	....	6.47
Calorific value determined:				
	Calories	8,019	....	7,294
	British thermal units	14,434	....	13,129

Boiler test: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 9.37 pounds; dry coal consumed per electrical horsepower per hour, 3.73 pounds.

Producer-gas test: None.

Coking test: Volatile constituents too low to make coke in a beehive oven; showed no tendency to coke; burned to ash.

Briquetting test: Requires more than the usual amount of pitch necessary for briquetting other Arkansas coals.

Arkansas No. 2.—Operator, Central Coal and Coke Company. Mine No. 12, at Bonanza, Sebastian County. Seam, Jenny Lind. Kind of coal, bituminous; over $1\frac{1}{8}$-inch screen.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	0.95	0.78	2.23
	Volatile matter	18.70	16.60	16.02
	Fixed carbon	73.38	73.53	72.55
	Ash	6.97	9.09	9.20
Ultimate.	Sulphur	2.12	2.50	1.87
	Hydrogen	....	....	4.24
	Carbon	....	....	78.83
	Nitrogen	....	....	1.38
	Oxygen	....	....	4.48
Calorific value determined:				
	Calories	7,993	....	7,639
	British thermal units	14,387	....	13,750

Boiler test. Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 9.73 pounds; dry coal consumed per electrical horsepower per hour, 3.59 pounds.

Producer-gas test: None.

Coking test: Volatile constituents too low to make coke in a beehive oven.

Briquetting test: Lack of suitable pitch prevented thorough test.

Arkansas Nos. 3, 4, and 6.—Operator, Western Coal and Mining Company. Mine No. 18, at Jenny Lind, Sebastian County. Seam, Jenny Lind. Kind of coal, semibituminous; over $1\frac{1}{8}$-inch screen, and slack, latter from 4 mines.

Cheminal analyses.

		Mine samples.		Car samples.	
				Lump and nut.	Slack.
Proximate.	Moisture	1.60	1.63	2.19	3.80
	Volatile matter	17.40	16.68	19.47	13.89
	Fixed carbon	73.09	69.03	66.71	68.50
	Ash	7.91	12.66	11.63	13.81
Ultimate.	Sulphur	1.42	1.46	1.28	1.26
	Hydrogen	....	....	4.17	....
	Carbon	....	....	75.31	....
	Nitrogen	....	....	1.53	....
	Oxygen	....	....	6.08	....
Calorific value determined:					
	Calories	7,868	....	7,480	....
	British thermal units	14,162	....	13,464	....

Boiler test: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 9.50 pounds; dry coal consumed per electrical horsepower per hour, 3.68 pounds.

Producer-gas test; None.

Coking test: Washed slack showed no tendency to coke; heavy coke made from briquets of unwashed charged into oven with a coking coal.

Washing test: Sulphur content of slack slightly and ash content notably reduced by jigging.

Briquetting test: Briquets can be manufactured on a commercial basis from slack mixed with 6 per cent of a suitable binder. Briquets produced were of excellent quality, hard and tough, with a crushing strength of 17,500 pounds per square inch.

Arkansas No. 5.—Operator, Western Coal and Mining Company. Mine No. 4, West of Coal Hill. Franklin County. Seam, Denning or Spadra. Kind of coal, semibituminous, half lump, half slack.

Chemical analyses.

		Mine samples.		Car sample.
Ultimate.	Moisture	1.38	1.80	2.36
	Volatile matter	14.76	15.00	12.68
	Fixed carbon	76.91	75.94	72.88
	Ash	6.95	7.26	12.08
Proximate.	Sulphur	1.52	1.94	1.99
	Hydrogen	....	....	3.82
	Carbon	....	....	76.44
	Nitrogen	....	....	1.37
	Oxygen	....	....	4.30
Calorific value determined:				
	Calories	7,868	7,961	7,366
	British thermal units	14,162	14,830	13,259

Boiler test: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 8.04 pounds; dry coal consumed, per electrical horsepower per hour, 4.34 pounds.

Briquetting test: Made excellent briquets when mixed with 6 per cent of suitable coal-tar pitch. Seventeen tons of these briquets were tested on a locomotive of the Missouri Pacific Railroad between St. Louis and Washington, Mo., in comparison with run-of-mine coal; the results favored the briquets.

CALIFORNIA.

Total production in 1905, 77,050 short tons; spot value, $382,725.

The principal feature of interest connected with the production of coal in California has been the apparently successful efforts to utilize the lignite or subbituminous coals produced in the State in the manufacture of briquets. During 1905 there were four of these plants in operation. One, at Stockton, was operated by the

San Francisco and San Joaquin Coal Company, using the lignite or subbituminous coal produced at the Tesla mine owned by the same company. Unfortunately, this plant was entirely destroyed by fire in November, and the plans for its rebuilding, this time at San Francisco, have been interrupted by the earthquake and fire which nearly destroyed that city in April of the present year. Another plant constructed in Oakland by the Western Fuel Company upon designs prepared by Mr. Robert Schorr, of San Francisco, was put in operation the latter part of the year. The third plant, a small one, owned by the Ajax Coal Company, of San Francisco, was in operation during most of the year, and the fourth, which was built at Antioch by the Pittsburg Coal Mining Company, upon plans prepared by Mr. Charles R. Allen, president of the company, was not completed until the latter part of the year. All of these plants were constructed for the purpose of using the California lignites or subbituminous coals, sometimes with and sometimes without a mixture of "Wellington" and other bituminous screenings obtained at the coal yards, and using asphaltic pitch as a binder. This pitch is obtained as a residue from California crude petroleum, which, when properly distilled, yields a pitch possessing excellent binding qualities.

The briquets make a good domestic fuel and are also much better adapted for use under boilers than the raw fuel from which they are made. The use of them or of the raw coals in California, however, has been much less than it would have been because of the greatly increased production of petroleum, and of its use for steam-raising purposes in both locomotive and stationary boilers. As a result of this the production of coal and lignite in California has shown a decreasing tendency during the last five years, as shown in the following table:

Distribution of the coal product of California, 1901–1905.

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.*				
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
1905	74,000	550	2,500	77,050	382,725	4.97	294	135

All of the coal produced in California is lignitic or subbituminous in character. There are in California a number of rather widely separated areas, the chief of which being the Mount Diablo and Corral Hollow fields in Alameda and Contra Costa counties, 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 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 15 coal-producing States. During the latter part of the 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 influenced 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 had 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, 1861–1905.

[Short tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1861	6,620	1876	128,049	1891	93,301
1862	23,400	1877	107,789	1892	85,178
1863	43,200	1878	134,237	1893	72,603
1864	50,700	1879	147,879	1894	67,247
1865	60,530	1880 [a]	236,950	1895	75,453
1866	84,020	1881	140,000	1896	78,544
1867	124,690	1882	112,592	1897	87,992
1868	143,676	1883	76,162	1898	145,888
1869	157,234	1884	77,485	1899	160,915
1870	141,890	1885	71,615	1900	171,708
1871	152,493	1886	100,000	1901	151,079
1872	190,859	1887	50,000	1 02	84,984
1873	186,611	1888	95,000	1903	104,673
1874	215,352	1889	119,820	1904	78,888
1875	166,638	1890	110,711	1905	77,050

a United States census, fiscal year.

RESULTS OF TESTS OF CALIFORNIA COAL.

The more important features of the results of tests made on California coal at the Geological Survey Coal Testing Plant [a] at St. Louis, Mo., are briefly summarized below. For more detailed reports see Professional Paper No. 48, and Bulletin No. 290 of the United States Geological Survey.

California No. 1.—Operator, San Francisco and San Joaquin Coal Company. Mine, Tesla, at Tesla Alameda County. Kind of coal, subbituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	17.59	18.02	18.51
	Volatile matter	41.09	39.22	35.33
	Fixed carbon	23.29	26.39	30.67
	Ash	18.03	16.37	15.49
	Sulphur	2.89	3.07	3.05
Ultimate.	Hydrogen			5.93
	Carbon			47.34
	Nitogen			.66
	Oxygen			27.53
Calorific value determined:				
	Calories		4,503	4,726
	British thermal units		8,105	8,365

Producer-gas test: Dry coal consumed per electrical horsepower per hour 2.38 pounds. This shipment was made for gas-producer test only. The results obtained were highly satisfactory in showing that the fuel is well adapted for use in the producer.

a For brief description of the equipment used in these tests see page 6.

COLORADO.

Total production in 1905, 8,826,429 short tons; spot value, $10,810,978.

Colorado's coal production in 1905 exceeded any previous record in the history of the State. Compared with that of 1904 the output in 1905 shows an increase of 2,168,074 short tons, or 32.5 per cent, nearly one-third, while compared with 1903, the year of previous maximum production, the record for 1905 shows a gain of 1,402,827 short tons, or 18.9 per cent. The tonnage in 1905 was more than double that of 1898 and nearly three times that of 1895. More than half of the increased production in 1905 over 1904 was plainly due to the growing iron industries in the State, for as shown in the following tables, over a million tons of the increase last year was in the amount of coal made into coke. In Las Animas County, where the principal coke-making establishments are located, the total production of coal increased from 2,808,953 short tons to 4,297,599 tons, a gain of 1,488,646 tons, or over 50 per cent, the amount of coal made into coke alone showing an increase of nearly 1,000,000 tons, or over 115 per cent. Another factor which assisted in the larger output for 1905 was the comparative freedom from labor disturbances. The smaller production in 1904 was due in most part to strikes in some of the larger mines, nearly 4,000 men being on strike for an average of 125 days, or about one-half of the year. In 1905 there was no occurrence of strikes in Colorado. The returns for 1905 show that 11,020 men were employed for an average of 255 days, as compared with 8,123 men for 261 days in 1904, and 9,229 men for 245 days in 1903. The places of many of the strikers in 1904 were filled by other and less experienced men, and the statistics for the 2 years show that the daily production per man was 3.14 tons, against 3.28 tons per man per day in 1903. The average tonnage per man per year was 804.4 tons, working 245 days, in 1903; 819.7 tons, working 261 days, in 1904; and 801 tons, working 255 days, in 1905.

One of the results arising from the restricted production in 1904 was an enhancement in values, the average price per ton advancing from $1.23 in 1903 to $1.31 in 1904. With the larger production in 1905 prices receded, the average for the State during the year being $1.22 per ton.

The statistics relating to the use of machines for undercutting coal show that while the amount of coal mined by machines in 1905 was considerably larger than in the preceding year, it was not quite equal to that reported in 1903, while the number of machines in use was less in 1905 than in either of the preceding years. In 1903 there were 157 machines in use, and the machine production amounted to 1,270,221 tons; in 1904, 125 machines were used in the mining of 945,965 tons, and in 1905, 121 machines produced 1,247,687 tons.

Mr. John D. Jones, State coal-mine inspector, reports that during the calendar year 1905 there were a total of 166 accidents, resulting in the death of 59 men and in injuries to 120 others. In all but two instances the fatal accidents occurred singly, and there were no serious explosions of gas or dust. One of the instances in which more than one miner was killed was at the Starkville mine of the Colorado Fuel and Iron Company, in Las Animas County. In this case a huge mass of rock fell upon and killed 3 men who were opening an old air course. Of the men killed, one was the mine foreman. The other case could hardly be called a mine accident, as it was the explosion of a steam radiator in the hoisting house. Two men who were sitting near the radiator were killed. As there were 11,020 men employed in the coal mines of Colorado in 1905, the death rate per thousand was 5.35. The number of tons mined for each life lost was 149,600.

The statistics of coal production in Colorado, by counties, during the last two years, with the distribution of the product for consumption, are shown in the following tables:

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.

Coal production of Colorado in 1905, 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	792,799	20,792	26,213	....	839,804	$1,269,223	$1.51	207	1,366
Delta	6,402	3,095	....	....	9,497	13,672	1.44	216	23
El Paso	164,792	19,468	4,515	....	188,775	250,806	1.33	226	331
Fremont	477,027	11,441	23,534	....	512,002	940,554	1.84	229	1,053
Garfield	166,970	3,628	1,965	....	172,563	190,422	1.10	256	176
Gunnison	424,022	3,894	11,037	74,364	513,317	772,264	1.50	227	582
Huerfano	1,389,742	5,362	31,536	....	1,426,640	1,958,148	1.37	244	1,760
La Plata	152,747	14,212	1,710	....	168,669	292,979	1.74	273	293
Las Animas	2,319,937	39,201	94,020	1,844,441	4,297,599	4,257,183	.99	286	4,706
Mesa	38,000	11,050	450	....	49,500	73,075	1.48	269	54
Routt	....	3,643	....	....	3,643	5,214	1.43	120	13
Weld	61,282	37,175	3,355	....	101,812	163,087	1.60	180	228
Other counties[a]	321,715	7,931	18,367	191,739	539,752	617,846	1.14	255	435
Small mines	....	2,856	....	....	2,856	6,505	2.28	......	....
Total	6,315,435	183,748	216,702	2,110,544	8,826,429	10,810,978	1.22	255	11,020

[a] Adams, Jefferson, Larimer, and Pitkin.

In the following table is exhibited the total production of the State, by counties, during the last 5 years, with the increases and decreases in 1905 as compared with 1904:

Coal production of Colorado, 1901–1905, by counties.

[Short tons.]

County.	1901.	1902.	1903.	1904.	1905.	Increase or decrease, 1905.
Boulder	482,975	806,371	803,924	736,824	839,804	+ 102,980
Delta		9,350	13,029	21,683	9,497	− 12,186
El Paso	175,979	218,549	207,797	248,013	188,775	− 59,238
Fremont	536,313	695,999	633,858	256,200	512,002	+ 255,802
Garfield	173,707	207,262	176,354	198,545	172,563	− 25,982
Gunnison	397,043	364,874	436,604	494,545	513,317	+ 18,772
Huerfano	918,609	1,189,313	1,319,666	1,187,905	1,426,640	+ 238,735
Jefferson				129,168	189,235	+ 60,067
La Plata	144,892	155,029	143,637	146,080	168,669	+ 22,589
Las Animas	2,476,138	3,245,271	3,213,743	2,808,953	4,297,599	+ 1,488,646
Pitkin	325,872	414,244	342,054	269,006	342,801	+ 73,798
Routt	1,558	3,180	2,775	5,568	3,643	− 1,925
Weld	33,374	73,681	94,492	118,862	101,812	− 17,050
Other counties	33,555	18,220	35,669	37,003	60,069	+ 23,066
Total	5,700,015	7,401,343	7,423,602	6,658,355	8,826,429	+ 2,168,074
Total value	$6,441,891	$8,397,812	$9,150,943	$8,751,821	$10,810,978	+$2,059,157

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 series, and with but few exceptions all of them are found in the Montana and Laramie formations. 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 50 per cent of the total output. Huerfano County, the second in importance, produces between 15 and 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.

The coal field which is now attracting most attention, and which promises to be developed in the near future, is the Yampa field of Routt County. This field is located in the valley of Yampa River below Steamboat Springs, and can easily be reached by railroad if the Denver, Northwestern and Pacific, which is now building through Gore Canyon, turns north into the Yampa Valley.

The coal beds of this field are ranged in three groups, separated generally by several hundred feet of barren strata. Beds of good bituminous coal, ranging from 6 to 20 feet in thickness, are of common occurrence, and generally there are a number of such beds in the different groups. Although these coal beds have heretofore been regarded as of Laramie age, recent work has shown that they belong in the Montana formation and that the overlying Laramie carries only thin beds of low-grade lignitic coal.

Most of the coal is of excellent quality, being a steaming coal of high grade. In general, the quality deteriorates in a westerly direction or away from the Park range. Anthracite occurs locally where the coal beds have been cut by intrusive masses, but the extent of such occurrences is small.

At present the only developments in this field are mines to supply local demands, but great activity is manifest in securing title to coal lands, and with the accomplishment of railroad connection with Denver doubtless coal mining on a commercial scale would be actively carried on.

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 6 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, 10 years apart (in 1884, 1894, and 1904), when the production showed a decrease of any importance, and only four altogether in 35 years. The largest decrease, as shown in the following table, was made in the "hard-times" year of 1894:

Coal production of Colorado, 1864–1905.

[Short tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1864	500	1878	200,630	1892	3,510,830
1865	1,200	1879	322,732	1893	4,102,389
1866	6,400	1880 [a]	462,747	1894	2,831,409
1867	17,000	1881	706,744	1895	3,082,982
1868	10,500	1882	1,061,479	1896	3,112,400
1869	8,000	1883	1,229,593	1897	3,361,703
1870 [a]	4,500	1884	1,130,024	1898	4,076,347
1871	15,600	1885	1,356,062	1899	4,776,224
1872	68,540	1886	1,368,338	1900	5,244,364
1873	69,997	1887	1,791,735	1901	5,700,015
1874	77,372	1888	2,185,477	1902	7,401,343
1875	98,838	1889	2,597,181	1903	7,423,602
1876	117,666	1890	3,077,003	1904	6,658,355
1877	160,000	1891	3,512,632	1905	8,826,429

[a] United States census, fiscal year.

RESULTS OF TESTS OF COLORADO COAL.

The more important features of the results of tests made on Colorado coals at the Geological Survey coal-testing plant [a] at St. Louis, Mo., are briefly summarized below. For more detailed reports see Professional Paper No. 48 and Bulletin No. 290 of the United States Geological Survey.

[a] For brief description of the equipment used in these tests see page 6.

Colorado No. 1.—Operator, Northern Coal and Coke Company. Mine, Simpson mine, at Lafayette, Boulder County. Kind of coal, black lignite or subbituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	20.02	21.84	18.68
	Volatile matter	33.81	34.00	34.88
	Fixed carbon	42.56	40.68	40.45
	Ash	3.61	3.48	5.99
Ultimate.	Sulphur	.52	.46	.55
	Hydrogen			6.07
	Carbon			57.46
	Nitrogen			1.15
	Oxygen			28.78
Calorific value determined:				
	Calories	5,687		5,635
	British thermal units	10,237		10,143

Boiler test: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 7.21 pounds; dry coal consumed per electrical horsepower per hour, 4.85 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.71 pounds.

Briquetting test: With 10 per cent of a coal-tar pitch gave hard briquets which were too brittle.

GEORGIA.

Total production in 1905, 351,991 short tons; spot value, $453,848.

Georgia is one of the 9 States whose coal production in 1905 was less than that of the preceding year, the output declining from 383,191 short tons in 1904 to 351,991 tons in 1905, a decrease of 31,200 short tons, or 8.14 per cent. The production in 1904 was 33,760 short tons less than that of 1903, in which year the largest tonnage in the history of the State was obtained. It is to be noted, however, that while the production in nearly every other State increased in 1905 prices declined, whereas in Georgia the production decreased and prices advanced, the average price per ton in 1905 being $1.29, against $1.22 in 1904. Aside from the decreased production and the advance in price, the record for 1905 was without particular interest. There were no strikes reported, and as a large part of the work in the mines is done by convicts leased from the State mining machines have not been introduced.

The statistics of production for the last 5 years, with the distribution of the product for consumption, are presented in the following table:

Coal production of Georgia since 1901.

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.*				
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
1905	224,695	1,148	7,113	119,035	351,991	453,848	1.29	270	801

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 northeasterly 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 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, 1860–1905.

[Short tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1860	1,900	1876	110,000	1891	171,000
1861	2,500	1877	120,000	1892	215,498
1862	3,500	1878	128,000	1893	372,740
1863	6,000	1879	140,000	1894	354,111
1864	10,000	1880	154,644	1895	260,998
1865	10,000	1881	168,000	1896	238,546
1866	8,000	1882	160,000	1897	195,869
1867	8,000	1883	155,000	1898	244,187
1868	10,000	1884	150,000	1899	233,111
1869	12,000	1885	150,000	1900	315,557
1870	15,000	1886	223,000	1901	342,825
1871	20,000	1887	313,715	1902	414,083
1872	25,000	1888	180,000	1903	416,951
1873	40,000	1889	225,934	1904	383,191
1874	60,000	1890	228,337	1905	351,991
1875	80,000				

IDAHO.

Total production in 1905, 5,782 short tons; spot value, $16,346.

There are several somewhat restricted areas in Idaho in which lignite beds occur, but until the last two or three years there has been little done in the way of mining. The districts from which any production has been obtained are the Horseshoe Bend and the Jerusalem districts, occupying the lower portion of a ridge between the Boise and Payette rivers; one near Salmon City, in Lincoln County, and one at the eastern edge of the State in Bingham and Fremont counties, where the Sublette field of Wyoming extends across the State line. The principal production in 1905 was from the Salmon district, in Lemhi County, 4,380 short tons having been mined there in 1905, when the total production of the State amounted to 5,782 tons. The output in

905, small as it was, was the largest, both in quantity and value, that the State has et produced. The total production of the State in 1904 was 3,330 short tons, valued t $12,230, against 4,250 tons, worth $13,250, in 1903, and 2,030 tons, valued at $5,180, 1 1902. No production was reported from the State in 1901, only 10 tons in 1900, nd 20 tons in 1899.

Coal production of Idaho, 1899–1905.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
899	20	$100	1903	4,250	$13,250
900	10	50	1904	3,330	12,230
901			1905	5,782	16,346
902	2,030	5,180			

ILLINOIS.

Total production in 1905, 38,434,363 short tons; spot value, $40,577,592.

Illinois still ranks next to Pennsylvania in the production of coal, although in the utput for 1905 the lead over West Virginia was by a very narrow margin, for while e tonnage for Illinois was the largest in the State's history, the increase over 1904 as small when compared with the progress exhibited by West Virginia. The pro-uction in West Virginia in 1905 amounted to 37,791,580 short tons, which was only 42,783 tons, or 1.67 per cent, less than that of Illinois. In 1904 Illinois led West irginia by more than 3,800,000 tons. It is highly probable that the returns for 906 will show West Virginia as the second coal-producing State, from the fact that hereas nearly all the mines of Illinois were shut down for several weeks in the pring of the year, pending an adjustment of the wage scale, those of West Virginia ere kept for the most part in continuous operation, and production was consider-bly augmented during this period in making up the shortage caused by the sus-ension not only in Illinois but in Indiana and Ohio as well.

Compared with 1904 the production of Illinois in 1905 shows a gain of 1,959,303 hort tons, or 4.3 per cent, while the increase in value was only $635,599, or 0.65 per ent, the average price per ton having declined from $1.10 in 1904 to $1.06 in 1905. ut of the 48 counties in which coal was produced in the last two years, there were 7 which exhibited an increased production in 1905, while decreases occurred in 31. he largest gain was made in Macoupin County, whose output increased 1,007,192 hort tons. Williamson came second with a gain of 772,555 tons, Fulton third with 82,034 tons, and La Salle fourth with 230,470 tons. The greatest losses were sus-ained by Vermilion County (449,808 tons) and Clinton County (275,438 tons).

The coal mines of Illinois gave employment in 1905 to 58,053 men, who worked n average of 201 days, against 54,685 men for 213 days in 1904, and 50,596 men for 28 days in 1903. These figures combined with the statistics of production show hat the average production for each man employed was 662.1 short tons in 1905, as ompared with 667 tons in 1904, and 731 tons in 1903. The average daily produc-ion for each man was 3.29 tons in 1905, 3.13 tons in 1904, and 3.21 tons in 1903. he smaller total tonnage per man in 1905 was due to the fewer number of days orked, while the larger average daily production per man was, in part at least, due o an increased tonnage with the use of machines.

The number of mining machines reported in use in 1905 was 882, against 643 in 904 and 553 in 1903. The machine-mined product increased from 7,110,902 tons in 904 to 8,697,547 in 1905. In 1903 the production of coal by machines was 7,381,027 hort tons. The percentage of the machine-mined coal to the total output in 1905 vas 22.6, compared with 19.5 in 1904 and 19.97 in 1903. Of the machines in use in

1905 758 were of the pick or puncher type and 123 were of the chain-breast pattern. Only 1 long-wall machine was reported.

More time was lost by strikes in the coal mines of Illinois in 1905 than for a number of years past, the record for last year showing that 15,289 men out of a total of 58,053 were on strike during the year and lost an average of 21 days each. In 1904 there were a few more men on strike but the total time lost was less than half that in 1905. The troubles in Illinois last year had their inception, to a large extent, in the enactment of a law by the Illinois legislature which required the coal operators to employ additional men to fire the shots placed by the miners. Under the wage-scale agreement the miners had, it is stated, contracted not to increase the expense of mining, and the operators, therefore, refused to pay the shot firers' wages, claiming that the miners in advocating the passage of the law had violated their agreement. This controversy was finally referred to Judge George Gray as arbitrator, who decided that the expenses should be equally divided between the miners and operators. There is good reason to believe that the law has not accomplished any good result and it is reported that at the next session of the legislature both sides will unite in an effort to have it repealed.

By far the larger number of mines in Illinois work 8 hours a day. In 1905 there were 583 mines out of 637 whose production amounted to 1,000 tons and which gave employment to 56,296 out of a total of 58,053 men that worked 8 hours. Nine mines, having an average of 8 men each, worked 9 or 9½ hours and 5 mines, employing 397 men in all, worked 10 hours.

The casualty record, as reported by Mr. David Ross, secretary of the bureau of labor statistics, shows that during the fiscal year ending June 30, 1905, there were 199 fatalities and 535 men injured. One hundred and two wives were made widows and 231 children were left fatherless. The death rate per thousand employees was 3.47 and the number of tons mined for each life lost was 191,156. The most serious accident of the year was an explosion of gas at the Zeigler mine, in Franklin County, through which 50 men lost their lives. Premature blasts or windy shots are the principal causes of the fatal accidents in the Illinois mines. The gas explosion at Zeigler is the only accident of this kind in five years that has resulted in the death of more than 5 persons. They occur principally in the winter season, from the fact that the coal mines are busier at that time than in the summer.

The production of coal in Illinois in 1904 and 1905 by counties, with the distribution of the product for consumption, is shown in the following tables:

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
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.

Coal production of Illinois in 1905, 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	1,561,360	69,818	70,077	....	1,701,255	$2,420,257	$1.42	210	4,405
Christian	714,914	96,721	67,725	....	879,360	970,859	1.10	173	1,238
Clinton	516,199	20,226	42,856	....	579,281	557,202	.96	112	1,263
Fulton	1,435,269	66,371	27,609	....	1,529,249	1,807,439	1.18	208	2,322
Gallatin	49,087	22,836	2,039	8,720	82,682	81,125	.98	171	241
Grunby	1,215,153	48,027	47,712	....	1,310,892	2,099,165	1.60	218	2,978
Henry	79,034	64,337	3,624	....	146,995	231,080	1.57	215	322
Jackson	731,725	26,853	60,263	....	818,841	1,004,875	1.23	194	1,313
Knox	14,555	43,829	588	....	58,972	88,471	1.50	187	146
Lasalle	1,392,664	318,330	61,994	....	1,772,988	2,669,324	1.51	244	3,584
Livingston	219,239	57,676	8,069	....	284,984	403,915	1.42	210	511
Logan	381,808	45,192	18,546	....	445,546	470,543	1.06	212	637
McDonough	11,484	7,860	152	....	19,496	35,397	1.82	149	86
McLean	33,920	99,001	27,000	....	159,921	246,552	1.54	276	336
Macoupin	2,966,312	96,163	115,009	....	3,177,484	2,883,316	.91	195	3,868
Madison	3,222,591	82,158	129,650	....	3,434,399	2,956,680	.86	202	3,702
Marion	812,636	131,463	65,660	....	1,009,759	906,656	.90	219	1,293
Marshall	451,049	25,540	23,083	....	499,672	703,598	1.41	259	1,029
Menard	361,032	35,470	18,764	....	415,266	414,490	1.00	209	673
Mercer	486,139	25,262	21,453	....	532,854	677,539	1.27	208	878
Montgomery	551,007	31,968	15,089	....	598,064	571,517	.96	201	858
Peoria	752,057	128,925	16,964	....	897,946	1,196,766	1.33	212	1,309
Perry	1,229,134	36,720	32,718	....	1,298,572	1,162,798	.90	158	2,458
Randolph	415,864	15,655	9,472	....	440,991	399,792	.91	185	669
Rock Island	10,900	56,051	1,432	....	68,383	114,854	1.68	181	119
St. Clair	3,027,890	195,293	106,731	....	3,329,914	2,764,326	.83	167	4,492
Saline	607,274	33,907	34,520	....	675,701	645,465	.96	155	950
Sangamon	3,874,213	320,395	129,655	....	4,324,263	4,135,614	.96	182	5,966
Scott	....	13,291	132	....	13,423	24,188	1.80	148	40
Shelby	68,996	28,014	7,206	....	104,216	173,639	1.67	220	259
Stark	3,300	18,770	655	....	22,725	41,129	1.81	157	77
Tazewell	153,736	73,254	4,383	....	231,373	267,246	1.16	240	366
Vermilion	2,123,738	167,602	50,898	....	2,342,238	2,260,442	.96	223	2,984
Warren	....	10,354	....	....	10,354	21,045	2.03	191	25
Will	118,322	14,289	5,346	....	137,957	209,256	1.52	243	343
Williamson	4,011,952	45,631	110,369	....	4,167,952	3,826,077	.92	218	4,572
Other counties[a] and small mines	555,562	317,968	36,865	....	910,395	1,134,955	1.25	226	1,741
Total	34,160,115	2,891,220	1,374,308	8,720	38,434,363	40,577,592	1.06	201	58,053

[a] Bond, Calhoun, Franklin, Green, Hancock, Jefferson, Kankakee, Macon, Morgan, Schuyler, Washington, and Woodford.

The increases and decreases, by counties, in 1905 as compared with 1904, and the production of each county during the last five years, are shown in the following table:

Coal production of Illinois from 1901 to 1905, by counties.

[Short tons.]

County.	1901.	1902.	1903.	1904.	1905.	Increase or decrease, 1905.
Bond	151,750	100,000	176,342	158,116	126,231	− 31,885
Brown	....	1,230	....	....	....	....
Bureau	1,594,803	1,769,642	1,846,642	1,821,867	1,701,255	− 120,612
Calhoun	5,923	3,000	5,300	6,500	4,727	− 1,773
Cass	....	....	1,768	810	....	− 810
Christian	616,373	936,036	1,024,392	838,943	879,360	+ 40,417
Clinton	765,060	834,318	920,391	854,719	579,281	− 275,438
Fulton	654,416	953,607	1,105,930	1,247,215	1,529,249	+ 282,034
Gallatin	4,800	30,911	72,205	92,908	82,682	− 10,226
Greene	3,808	6,000	6,639	5,986	4,435	− 1,551
Grundy	1,269,741	1,414,479	1,392,427	1,334,422	1,310,892	− 23,530
Hamilton	....	....	1,200	....	....	....
Hancock	6,106	13,400	7,380	7,923	3,300	− 4,623
Henry	89,465	138,312	156,870	149,259	146,995	− 2,264
Jackson	870,093	930,487	913,283	889,607	818,841	− 70,766
Jefferson	50,000	25,090	28,245	32,788	25,925	− 6,863
Jersey	....	3,520	....	....	....	....
Johnson	1,010	3,850	2,333	700	....	− 700
Kankakee	67,195	48,439	74,226	....	700	+ 700
Knox	78,636	85,851	105,055	73,806	58,972	− 14,834
Lasalle	1,751,758	1,846,236	1,882,589	1,542,518	1,772,988	+ 230,470
Livingston	307,267	395,083	122,773	186,638	284,984	+ 98,346
Logan	161,611	268,707	469,578	350,037	445,546	+ 95,509
McDonough	31,337	34,636	28,104	26,211	19,496	− 6,715
McLean	144,959	175,000	198,100	198,513	159,921	− 38,592
Macon	86,468	100,000	110,000	180,851	231,235	+ 50,384
Macoupin	1,960,038	2.185,325	2,414,499	2,170,292	3,177,484	+1,007,192
Madison	1,911,381	2,374,684	2,950,496	3,341,989	3,434,399	+ 92,410
Marion	844,816	922,656	1,095,952	1,010,508	1,009,759	− 749
Marshall	417,444	458,186	479,641	467,724	499,672	+ 31,948
Menard	390,931	471,958	483,447	463,985	415,266	− 48,719
Mercer	563,350	640,141	642,746	566,801	532,854	− 33,947
Montgomery	367,326	619,448	458,987	499,218	598,064	+ 98,846
Morgan	3,000	4,780	4,358	4,737	4,565	− 172
Peoria	659,701	852,375	958,982	912,422	897,946	− 14,476
Perry	632,039	991,344	1,236,368	1,296,962	1,298,572	+ 1,610
Randolph	368,951	456,984	535,895	531,465	440,991	− 90,474
Rock Island	68,356	83,418	69,641	86,219	68,383	− 17,836
St. Clair	2,298,843	2,822,248	3,464,069	3,417,632	3,329,914	− 87,718
Saline	163,584	297,571	433,328	568,670	675,701	+ 107,031
Sangamon	3,277,939	4,172,722	4,470,962	4,219,199	4,324,263	+ 105,064
Schuyler	5,552	18,457	12,927	11,673	2,880	− 8,793
Scott	23,680	27,435	24,776	19,409	13,423	− 5,986
Shelby	114,192	87,112	108,508	129,846	104,216	− 25,630
Stark	13,400	29,043	43,166	27,657	22,725	− 4,932
Tazewell	145,569	173,018	253,653	194,891	231,373	+ 36,482
Vermilion	2,260,964	2,585,291	2,955,071	2,792,046	2,342,238	− 449,808
Warren	10,300	16,077	14,989	10,784	10,354	− 430
Washington	25,700	56,835	91,766	97,069	87,913	− 9,156

Coal production of Illinois from 1901 to 1905, by counties—Continued.

County.	1901.	1902.	1903.	1904.	1905.	Increase or decrease, 1905.
Will	56,646	40,792	49,240	76,538	137,957	+ 61,419
Williamson	1,743,052	2,325,942	2,881,653	3,395,397	4,167,952	+ 772,555
Woodford	142,219	101,567	*a* 123,501	*b* 105,185	*b* 348,707	+ 243,522
Small mines	150,000	6,130	46,711	56,405	69,777	+ 13,372
Total	27,331,552	32,939,373	36,957,104	36,475,060	38,434,363	+1,959,303
Total value	$28,163,937	$33,945,910	$43,196,809	$39,941,993	$40,577,592	+ $635,599

a Includes production of Wabash County. *b* Includes production of Franklin County.

The coal fields of Illinois are included in the Eastern Interior Field, which underlies the greater part of Illinois, the southwest part of Indiana, and part of western Kentucky. Nearly three-fourths of the entire State is underlain by productive coal measures, the total area being estimated at 42,900 square miles. It has been considered the largest coal-bearing area in any one State in the Union, though more definite knowledge may show either North Dakota or Montana to equal or excel it. There are more counties in Illinois in which coal is produced than any other of the United States, the production in 1905 being reported from 51 counties.

The coals of the State have never been systematically and thoroughly studied, so that statements as to the number of coals and their correlation and extent can not be fully relied upon. The revival of the geological survey during 1905 and the plans for future work already made give promise of soon placing our knowledge of the coals of the State on a more exact basis. Many of the statements made about the coals of Indiana, being based on recent detailed work, will doubtless prove true for Illinois also.

The coal field in Illinois occupies a basin. In the center the lower coals are at least 1,000 feet deep, and the outcropping rocks belong to the upper or nonproductive coal measures. Around the edge of the basin the productive measures outcrop in a broad belt. In this belt there appear to be 6 coals that are locally or generally workable. Some of these coals appear to underlie the center of the basin as well as its edges, often with a workable thickness. In the Grundy district, on the northeastern edge of the field, along the north and west side, the coals resemble the lowest coal of Indiana in usually being thin, occurring in small basins, and frequently more than making up by being of excellent quality. Coal No. 2 is the principal coal of the edges of the field. Of the higher coals, Nos. 5, 6, and 7 are the principal ones, their importance being in the order named. These coals run from 5 to 6 feet thick in the north part of the field, but to the south increase until they are from 6 to 9 feet thick.

Most of the coal of the State is reached by shafts, many of which are well equipped with double platform cages hoisting two cars at a time. While the room and pillar method largely prevails, many of the thinner coals are worked by long-wall methods, especially the mines on coal No. 2. As a whole, the mines are well equipped with modern machinery and many of them have a large output.

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 Crèvecœur, 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 1905, inclusive, and for the years for which there is no special information the production has been estimated by the writer.

Coal production of Illinois, 1833–1905.

[Short tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1833	6,000	1858	490,000	1882	9,115,653
1834	7,500	1859	530,000	1883	12,123,456
1835	8,000	1860 [a]	728,400	1884	12,208,075
1836	10,000	1861	670,000	1885	11,834,459
1837	12,500	1862	780,000	1886	11,175,241
1838	14,000	1863	890,000	1887	12,423,066
1839	15,038	1864	1,000,000	1888	14,328,181
1840 [a]	16,967	1865	1,260,000	1889	12,104,272
1841	35,000	1866	1,580,000	1890	15,292,420
1842	58,000	1867	1,800,000	1891	15,660,698
1843	75,000	1868	2,000,000	1892	17,862,276
1844	120,000	1869	1,854,000	1893	19,949,564
1845	150,000	1870 [a]	2,624,163	1894	17,113,576
1846	165,000	1871	3,000,000	1895	17,735,864
1847	180,000	1872	3,360,000	1896	19,786,626
1848	200,000	1873	3,920,000	1897	20,072,758
1849	260,000	1874	4,203,000	1898	18,599,299
1850	300,000	1875	4,453,178	1899	24,439,019
1851	320,000	1876	5,000,000	1900	25,767,981
1852	340,000	1877	5,350,000	1901	27,331,552
1853	375,000	1878	5,700,000	1902	32,939,373
1854	385,000	1879	5,000,000	1903	36,957,104
1855	400,000	1880	6,115,377	1904	36,475,060
1856	410,000	1881	6,720,000	1905	38,434,363
1857	450,000				

[a] United States census, fiscal year.

RESULTS OF TESTS OF ILLINOIS COALS.

The more important features of the results of tests made on Illinois coals at the Geological Survey coal-testing plant [a] at St. Louis, Mo., are briefly summarized below. For more detailed reports see Professional Paper No. 48 and Bulletin No. 290 of the United States Geological Survey.

[a] For a brief description of the equipment used in these tests see page 6.

Illinois No. 1.—Operator, Western Anthracite Coal and Coke Company. Mine, St. Louis and O'Fallon No. 1, 5½ miles south of O'Fallon, St. Clair County. Seam, Belleville, or No. 6. Kind of coal, bituminous, over 1-inch screen, and slack.

Chemical analyses.

		Mine samples.		Car samples.	
				Lump and nut.	Slack.
Proximate.	Moisture	11.17	10.06	9.75	12.03
	Volatile matter	39.31	40.33	37.48	31.86
	Fixed carbon	39.20	39.54	39.57	33.67
	Ash	10.32	10.07	13.20	22.44
Ultimate.	Sulphur	4.22	4.04	4.10	4.00
	Hydrogen	....	....	5.31	5.04
	Carbon	....	....	59.72	50.22
	Nitrogen	....	....	1.03	0.72
	Oxygen	....	....	16.64	17.58
Calorific value determined:					
	Calories	6,235	....	6,125	5,083
	British thermal units	11,223	....	11,025	9,149

Boiler test, lump and nut: Water evaporated by one pound of dry coal, at and from a temperature of 212° F., 7.21 pounds; dry coal consumed per electrical horsepower per hour, 4.85 pounds. Slack: Water evaporated, 8 pounds; coal consumed, 4.38 pounds.

Coking test: Too high in ash and sulphur to make coke suitable for blast-furnace use. A charge of unwashed lump coal yielded some small pieces of coke mixed with charred coal and ash; washed slack burned 64 hours 37.6 per cent fair-looking coke, high in sulphur, but can be used for lead and zinc smelting. Ash content of slack coal reduced to 9.19 per cent by washing in modified Stewart jig, but sulphur, present as gypsum, is reduced very slightly by washing.

Briquetting test: With hard pitch gave briquets that were too soft.

Illinois No. 3.—Operator, Southern Illinois Coal Mining and Washing Company. Mine, No. 3, Marion, Williamson County. Seam, Carterville, or No. 7. Kind of coal. bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	7.50	7.34	8.50
	Volatile matter	31.68	34.29	29.47
	Fixed carbon	56.67	50.84	50.75
	Ash	7.15	7.53	11.28
Ultimate.	Sulphur	0.99	2.04	1.72
	Hydrogen	....	....	5.09
	Carbon	....	....	65.48
	Nitrogen	....	....	1.39
	Oxygen	....	....	15.04
Calorific value determined:				
	Calories	6,881	....	6,542
	British thermal units	12,386	....	11,776

Boiler test: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 8.04 pounds; dry coal consumed per electrical horsepower per hour, 4.34 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.79 pounds.

Coking test: Unwashed coal did not coke; washed coal after burning 90 hours yielded 49.06 per cent of very brittle coke.

Washing test: A sample containing 10.50 per cent ash and 1.45 per cent sulphur showed after washing 5.86 per cent ash and 1.41 per cent sulphur.

Illinois No. 4.—Operator, Donk Brothers Coal and Coke Company. Mine, No. 3, about 1 mile west of Troy, Madison Connty. Seam, Belleville, or No. 6. Kind of coal, bituminous, over 2-inch screen, and slack.

Chemical analyses.

		Mine samples.		Car samples.	
				Lump.	Washed slack.
Proximate.	Moisture	15.09	14.42	12.91	17.02
	Volatile matter	31.00	32.18	31.90	30.60
	Fixed carbon	46.49	44.59	43.55	35.59
	Ash	7.42	8.81	11.64	16.79
Ultimate.	Sulphur	.83	1.52	1.32	3.29
	Hydrogen	....	....	5.43	5.50
	Carbon	....	....	60.74	50.77
	Nitrogen	....	....	1.15	....
	Oxygen	....	....	19.72	....
Calorific value determined:					
	Calories	6,195	....	6,002	5,177
	British thermal units	11,151	....	10,804	9,319

Boiler test: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 7.37 pounds; dry coal consumed per electrical horsepower per hour, 4.73 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.76 pounds.

Coking test, with slack: No coke produced.

Washing test, with slack: Rewashing with New Century jig materially reduced ash.

Briquetting test: Seven tests with different binders in varying proportions were made. The best results were with 8 per cent of a pitch obtained as a by-product in manufacturing gas from heavy petroleum. The resultant briquets were very hard and tough, having a crushing strength of 12,810 pounds to the square inch.

Illinois No. 6.—Operator, Clover Leaf Coal Company. Mine, No. 1, shaft at Coffeen, Montgomery County. Seam, Pana, or No. 5. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.			Car samples.	
Proximate.	Moisture	14.89	13.94	12.90	14.43	11.93
	Volatile matter	34.80	33.93	33.77	29.48	29.99
	Fixed carbon	42.44	41.22	42.25	42.81	43.90
	Ash	7.87	10.91	11.08	13.28	14.18
Ultimate.	Sulphur	3.61	3.79	3.78	4.01	4.29
	Hydrogen	....	....	....	5.49	5.21
	Carbon	....	....	....	54.59	56.94
	Nitrogen	....	....	....	1.11	1.01
	Oxygen	....	....	....	21.52	18.37
Calorific value determined:						
	Calories	5,177	6,120	6,031	5,591	5,724
	British thermal units	9,319	11,016	10,856	10,064	10,303

Boiler tests: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 8.73 and 6.56 pounds; dry coal consumed per electrical horsepower per hour, 4.00 and 5.32 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.79 pounds.

Washing test: Coal crushed to 2 inches and passed over modified Stewart jig showed reduction in ash and slight reduction in sulphur.

Illinois No. 7.—Operator, Lumaghi Coal Company. Mine, No. 2, near Collinsville, Madison County. Kind of coal, bituminous, slack, nut, and run of mine.

Chemical analyses.

		Mine samples.		Car samples.	
				Nut.	Run of mine.
Proximate.	Moisture	12.27	11.87	11.46	10.83
	Volatile matter	37.22	36.57	34.98	36.24
	Fixed carbon	39.16	39.98	36.25	39.75
	Ash	11.35	11.58	17.31	13.18
Ultimate.	Sulphur	4.66	4.75	4.40	4.53
	Hydrogen			5.05	5.35
	Carbon			54.56	58.59
	Nitrogen		1.02	.94	.99
	Oxygen			17.74	17.37
Calorific value determined:					
	Calories		5,982	5,570	6,009
	British thermal units		10,768	10,026	10,816

Boiler test, using plain grate, burning slack coal: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 8.02 pounds; dry coal consumed per electrical horsepower per hour, 4.36 pounds; using plain grate, burning run of mine, the figures were 7.42 and 7.20. and 4.70 and 4.85 pounds.

Producer-gas tests: Dry slack coal consumed per electrical horsepower per hour, 4.30 pounds; dry nut coal, 2.12 pounds.

Coking test: Good hard coke high in sulphur from both washed and unwashed coal.

Washing test: Using modified Stewart jig, sulphur and ash content of slack coal reduced from 4.06 and 20.09 to 3.25 and 8.59 per cent, respectively; with run of mine, reductions were from 4.53 and 13.18 to 3.65 and 9.30 per cent.

Illinois No. 8.—Operator, Dering Coal Company. Mine, Paisley, at Paisley, Montgomery County. Kind of coal, bituminous, nut.

Chemical analysis.

		Car sample.
Proximate.	Moisture	13.20
	Volatile matter	34.33
	Fixed carbon	39.94
	Ash	12.53
Ultimate.	Sulphur	4.47
	Hydrogen	5.51
	Carbon	57.25
	Nitrogen	1.02
	Oxygen	19.22
Calorific value determined:		
	Calories	5,841
	British thermal units	10,514

Boiler tests: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 6.22 and 6.39 pounds; dry coal consumed per electrical horsepower per hour, 5.61 and 5.48 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.72 pounds.

Illinois No. 9.—Operator, Mount Olive and Staunton Coal Company. Mine, No. 2, at Staunton, Macoupin County. Kind of coal, bituminous, lump, and run of mine.

Chemical analyses.

		Mine samples.		Car sample run of mine.	Car sample lump coal.
Proximate.	Moisture	13.29	15.27	13.54	13.72
	Volatile matter	37.07	36.19	35.69	36.24
	Fixed carbon	40.74	39.34	40.03	39.72
	Ash	8.90	9.20	10.74	10.32
Ultimate.	Sulphur	4.12	3.70	4.03	3.96
	Hydrogen	....	....	5.71	5.74
	Carbon	....	....	58.69	58.95
	Nitrogen	....	....	.95	.98
	Oxygen	....	....	19.88	20.05
Calorific value determined:					
	Calories	6,201	....	6,004	6,039
	British thermal units	11,162	....	10,807	10,870

Boiler tests, run of mine coal: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 6.81, 6.50, and 6.75 pounds; dry coal consumed per electrical horsepower per hour, 5.13, 5.37, and 5.17 pounds.

Producer-gas test, lump coal: Dry coal consumed per electrical horsepower per hour, 1.77 pounds.

Washing test, run of mine coal crushed to 2 inches, using modified Stewart jig: Ash before washing, 10.74 per cent; after washing, 7.37; sulphur before washing, 4.03; after washing, 3.38 per cent.

Illinois No. 10.—Operator, Dering Coal Company. Mine, West Frankfort, at West Frankfort, Franklin County. Kind of coal, bituminous, slack.

Chemical analysis.

		Car sample.
Proximate.	Moisture	9.50
	Volatile matter	31.98
	Fixed carbon	47.08
	Ash	11.44
Ultimate.	Sulphur	1.45
	Hydrogen	5.31
	Carbon	63.83
	Nitrogen	1.36
	Oxygen	16.61
Calorific value determined:		
	Calories	6,392
	British thermal units	11,506

Boiler tests: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F. 7.65 and 7.04 pounds; dry coal consumed per electrical horsepower per hour, 4.50 and 4.96 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.45 pounds.

Washing test, using modified Stewart jig: Ash before washing, 11.44 per cent; sulphur, 1.45 per cent; ash after washing, 6.67; sulphur, 1.38 per cent.

Illinois No. 11.—Operator, St. Louis and Big Muddy Coal Company. Mine, Daw's shaft, near Carterville, Williamson County. Kind of coal, bituminous screenings, egg, lump, and run of mine, also No. 4 washed and No. 5 washed.

Chemical analyses.

		Mine sample.	Car sample screenings and egg.	Car sample mine run and lump.	Car sample No. 4 and No. 5 washed.
Proximate.	Moisture	8.30	7.76	8.86	8.61
	Volatile matter	33.75	31.44	31.25	32.40
	Fixed carbon	48.69	50.19	48.23	51.33
	Ash	9.26	10.61	11.66	7.66
Ultimate.	Sulphur	2.82	1.97	2.46	1.65
	Hydrogen		5.14	5.24	5.38
	Carbon		66.55	64.29	68.14
	Nitrogen		1.32	1.29	1.34
	Oxygen		14.41	15.06	15.83
Calorific value determined:					
	Calories	6,666	6,643	6,501	6,798
	British thermal units	11,999	11,957		12,236

Boiler tests, with screenings: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 8.29 pounds; dry coal consumed per electrical horsepower per hour, 4.56 pounds; with run of mine coal, water evaporated, 7.49, 7.48, and 7.19 pounds; coal consumed, 4.66, 4.67, and 4.85 pounds; with lump coal, water evaporated, 7.19 and 7.31 pounds; coal consumed, 4.85 and 4.78 pounds.

Producer-gas test, egg coal: Dry coal consumed per electrical horsepower per hour, 1.36 pounds; No. 5 washed dry coal consumed, 2.98.

Coking test: No. 3 washed and finely crushed burned 48 hours; gave 54 per cent good strong coke with 3 per cent breeze.

Illinois No. 12.—Operator, Western Coal and Mining Company. Mine, Bush No. 1, at Bush, Williamson County. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	8.29	8.41	8.20
	Volatile matter	31.19	34.27	32.26
	Fixed carbon	49.69	45.44	46.59
	Ash	10.83	11.88	12.95
Ultimate.	Sulphur	2.81	3.63	3.48
	Hydrogen			5.09
	Carbon			62.52
	Nitrogen			1.10
	Oxygen			14.86
Calorific value determined:				
	Calories	6,576		6,312
	British thermal units	11,837		11,362

Boiler test: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 7.81 and 8.19 pounds; dry coal consumed per electrical horsepower per hour, 4.50 and 4.26 pounds.

Washing test, using modified Stewart jig: Ash, before washing, 12.95 per cent; sulphur, 3.48 per cent; ash, after washing, 8.91 per cent; sulphur, 2.48 per cent.

Illinois No. 13.—Operator, Benton Coal Company. Mine, Benton, at Benton, Franklin County. Kind of coal, bituminous, through 6-inch and over 1½-inch screen.

Chemical analyses

		Mine samples.		Car sample.
Proximate.	Moisture	10.28	9.46	8.31
	Volatile matter	32.04	33.55	31.65
	Fixed carbon	49.74	48.87	49.56
	Ash	7.94	8.12	10.48
Ultimate.	Sulphur	1.06	1.63	1.55
	Hydrogen			5.18
	Carbon			65.83
	Nitrogen			1.48
	Oxygen			15.48
Calorific value determined:				
	Calories		6,661	6,515
	British thermal units		11,990	11,727

Boiler test, washed coal: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 9.08 pounds; dry coal consumed per electrical horsepower per hour, 3.84 pounds.

Producer-gas test, coal unwashed: Dry coal consumed per electrical horsepower per hour, 1.59 pounds.

Coking test: Unwashed coal, crushed, burned 65 hours, gave 44.65 per cent coke; washed coal gave 46.0 per cent good hard coke lower in ash and sulphur than that from unwashed coal.

Washing test, coal crushed to 2 inches, using modified Stewart jig: Ash before washing, 10.48 per cent; after washing, 7.49 per cent; sulphur before washing, 1.55 per cent, after washing, 1.27 per cent.

Illinois No. 14.—Operator, Capital Coal Company. Mine, No. 2, east side of Springfield, Sangamon County. Kind of coal, bituminous, over 1½-inch bar screen (lump).

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	13.89	14.45	12.77
	Volatile matter	33.96	34.79	34.68
	Fixed carbon	40.89	40.10	40.77
	Ash	11.26	10.66	11.78
Ultimate.	Sulphur	3.83	3.46	4.16
	Hydrogen			5.49
	Carbon			58.74
	Nitrogen			1.09
	Oxygen			18.74
Calorific value determined:				
	Calories	5,909		5,976
	British thermal units	10,636		10,757

Boiler test, raw coal: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 7.58 pounds; dry coal consumed per electrical horsepower per hour, 4.61 pounds; washed coal, water evaporated, 7.71 pounds; dry coal consumed, 4.53 pounds.

Producer-gas test, unwashed coal: Dry coal consumed per electrical horsepower per hour, 1.56 pounds.

Washing test: Crushed to 2 inches, using modified Stewart jig; ash before washing, 11.78 per cent; after washing, 9.37 per cent; sulphur before washing, 4.16 per cent; after washing, 3.29 per cent.

Illinois No. 15.—Operator, Pettinger and Davis. South mine, at Centralia, Marion County. Kind of coal, bituminous, over 6-inch screen and some smaller coal.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	10.25	11.88	9.95
	Volatile matter	37.43	35.84	34.76
	Fixed carbon	39.79	43.45	42.06
	Ash	12.53	8.83	13.23
Ultimate.	Sulphur	3.70	3.25	3.87
	Hydrogen			5.25
	Carbon			59.64
	Nitrogen			1.04
	Oxygen			16.97
Calorific value determined:				
	Calories	6,154		6,089
	British thermal units	11,077		10,960

Boiler tests, raw coal: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 7.62 pounds; dry coal consumed per electrical horsepower per hour, 4.58 pounds; with washed coal, water evaporated, 8.59 pounds; dry coal consumed, 4.06 pounds.

Producer-gas test, raw coal: Dry coal consumed per electrical horsepower per hour, 1.63 pounds.

Washing test: Crushed to 2 inches, modified Stewart jig; raw coal, ash 13.23 per cent, sulphur 3.87 per cent; washed coal, ash 8.41 per cent, sulphur 3.00 per cent.

Illinois No. 16.—Operator, Big Muddy Coal and Iron Company. Mine, No. 7, at Herrin, Williamson County. Kind of coal, bituminous, over 3-inch screen (lump and egg).

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	9.37	8.59	8.43
	Volatile matter	30.69	31.07	30.08
	Fixed carbon	52.57	53.37	51.89
	Ash	7.37	6.97	9.60
Ultimate.	Sulphur	1.25	1.78	1.14
	Hydrogen			5.18
	Carbon			67.33
	Nitrogen			1.50
	Oxygen			15.25
Calorific value determined:				
	Calories	6,699		6,644
	British thermal units	12,058		11,959

Boiler test: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 9.08 pounds; dry coal consumed per electrical horsepower per hour, 3.85 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.67 pounds.

Coking test: Crushed washed coal burned 66 hours yielded 55.79 per cent of dull gray coke of poor physical quality.

Washing test: Modified Stewart jig; coal crushed to 2 inches; raw coal, ash 9.60 per cent, sulphur 1.14 per cent; washed coal, ash 8 per cent, sulphur 1.02 per cent.

Illinois No. 18.—Operator, Lasalle County Carbon Coal Company. Mine, Lasalle shaft, at Lasalle, La Salle County. Kind of coal, bituminous, over 6-inch screen.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	13.87	15.55	12.39
	Volatile matter	37.26	36.21	36.89
	Fixed carbon	38.56	40.66	41.80
Proximate. / Ultimate.	Ash	10.31	7.58	8.92
Ultimate.	Sulphur	3.44	3.01	3.92
	Hydrogen	....	....	5.85
	Carbon	....	....	61.29
	Nitrogen	....	....	1.00
	Oxygen	....	....	19.02
Calorific value determined:				
	Calories	6,103	....	6,333
	British thermal units	10,985	....	11,399

Boiler tests: Water evaporated by 1 pound of dry raw coal, at and from a temperature of 212° F., 7.94 pounds; dry coal consumed per electrical horsepower per hour, 4.40 pounds. With washed coal the results were: Water evaporated, 9.23 pounds; coal consumed per electrical horsepower per hour, 3.78 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.51 pounds.

Washing test: Coal crushed to 2 inches; modified Stewart jig used; raw coal, ash 8.92 per cent, sulphur 3.92 per cent; washed coal, ash 5.77 per cent, sulphur 2.98 per cent.

Illinois No. 19.—Operator, Zeigler Coal Company. Mine, Zeigler, at Zeigler, Franklin County. Kind of coal, bituminous, over ¾-inch shaking screen ("¾-inch") and over 1½-inch shaking screen ("3-inch").

Chemical analyses.

		Mine samples.		Car samples.	
Proximate.	Moisture	9.90	10.53	14.91	10.72
	Volatile matter	28.67	29.06	26.66	29.86
	Fixed carbon	53.69	53.01	49.50	50.06
Proximate. / Ultimate.	Ash	7.74	7.40	8.93	9.36
Ultimate.	Sulphur	.48	.47	.52	.91
	Hydrogen	....	....	5.42	5.30
	Carbon	....	....	62.76	66.74
	Nitrogen	....	....	1.35	1.40
	Oxygen	....	....	21.02	16.29
Calorific value determined:					
	Calories	6,667	....	6,088	6,492
	British thermal units	12,001	....	10,958	11,686

Boiler tests, "¾-inch" coal: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 8.33, 8.80, and 8.61 pounds; dry coal consumed per electrical horsepower per hour, 4.19, 3.97, and 4.06 pounds. With "3-inch" coal: Water evaporated, 9.10 pounds; consumption of coal per electrical horsepower per hour, 3.84 pounds.

Producer-gas test: Dry coal ("3-inch") consumed per electrical horsepower per hour, 1.33 pounds.

Coking test: Neither raw nor washed coal would coke in a beehive oven.

INDIANA.

Total production in 1905, 11,895,252 short tons; spot value, $12,492,255.

Coal production in Indiana has increased rapidly and uninterruptedly during the last 10 years, and has in fact been trebled in that period—from 3,905,779 short tons in 1896 to nearly 12,000,000 tons in 1905. Compared with 1904 the output in 1905 shows an increase of 1,053,063 short tons, or a little less than 10 per cent in quantity, and of $487,955, or 4 per cent, in value. The principal increases in the last few years have been in Greene, Sullivan, Vermilion, and Vigo counties. These increases have been particularly notable in Greene and Sullivan counties, where a large amount of development has taken place. The production in these two counties has more than trebled in the last 5 years, while two counties, formerly among the most important producers (Clay and Parke), are showing a decreasing tendency. The largest gain in production in 1905 was made by Sullivan County, whose output increased 510,606 short tons, or 25 per cent over that of 1904. Vigo County ranked second in increased production, with a gain of 433,353 short tons, a little less than 25 per cent, and Vermilion County exhibited an increase of 234,240 tons, or 22 per cent. Clay County's production fell off 178,520 tons, and that of Parke County decreased 173,687 tons.

The statistics of labor employed in the coal mines of Indiana show that there was a decided increase in the number of men employed and an equally decided decrease in the number of days worked. This is probably more apparent than real, and is doubtless due to the large number of changes in ownership which took place in 1905, by which certain men were reported twice, but for two different periods, thus reducing the average time but apparently increasing the number of employees. The total number of men reported in 1905 was 25,323, working an average of 151 days, against 19,587 men for 177 days in 1904, and 17,017 men for 197 days in 1903. Dividing these figures into the total tonnage reported it is found that there has been a decreasing tendency in the production of each employee. In 1903 the average amount of coal produced per man was 634.3 tons; in 1904 it fell to 553.5 tons, and again in 1905 to 469.7 tons. The average daily production per man has decreased from 3.22 tons in 1903 to 3.13 tons in 1904, and 3.11 tons in 1905. These decreases have occurred in spite of a distinct increase in the number of machines used and in the machine-mined tonnage. In 1905 there were 75 mines which reported a total of 506 machines, and in which were produced an aggregate of 4,207,246 short tons, or 35.4 per cent of the total output, against 403 machines and 3,613,532 tons of machine-mined coal (33.3 per cent of the total) in 1904, and 329 machines, producing 3,334,961 tons (30.9 per cent of the total) in 1903.

The entire coal-mining business of Indiana may be said to be conducted on an 8-hour basis. During 1905, out of a total of 25,323 men employed, there were 24,484 distributed among 271 mines that reported the hours per day worked at 8. Two small mines reported 9 hours, and three of still less importance reported 10 hours. In 1904, 18,727 men out of a total of 19,587 were reported as working 8 hours per day.

Through the courtesy of Mr. James Epperson, inspector of mines, the writer has obtained the following information regarding the occurrence of accidents in the coal mines of Indiana during 1905. The casualty record for 1905, according to Mr. Epperson, included 38 fatal accidents, involving the death of 47 men. With one exception, all of the accidents of the year resulted in the death of only 1 man each. The greatest number of deaths from any one cause was from falling slate, 13 of the 47 men being killed in this way. The one accident in which more than 1 man was killed was due to an explosion caused by a misplaced shot in the Oswald mine of the Princeton Coal and Mining Company at Gibson. This accident occurred on March 10 and resulted in the death of 10 miners. In this instance 5 dead bodies were taken from the mine, and 5 of the fatally injured lived from 1 week to 10 days. Of the total of 47 fatalities 31 resulted in instant death and 16 men were so badly injured that they lived but from a few hours to 10 days. As a result of these accidents 27 wives were made widows and 60 children were left fatherless.

In addition to the fatal accidents there were 103 serious accidents, which were not attended with fatal results, and 101 minor accidents. The death rate per thousand employees was 1.86, and the number of tons of coal mined per life lost was 253,090.

The statistics of production in Indiana in 1904 and 1905, by counties, with the distribution of the product for consumption, are shown in the following tables:

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	2,333,473	53,959	52,988	a 2,440,420	2,690,470	1.10	179	3,444
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	9,881,510	653,187	307,492	a10,842,189	12,004,300	1.11	177	19,587

a In the report for 1904 the production of Indiana was given at 10,934,379 short tons, valued at $12,105,709. After this report had been printed it was discovered that the tonnage of one mine in Greene County had been duplicated in the tabulation. The production was accordingly overstated by about 90,000 tons.

Coal production of Indiana in 1905, 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	694,779	47,278	39,517	781,574	$1,067,393	$1.37	128	3,326
Daviess	65,154	33,739	2,536	101,429	142,709	1.41	188	244
Dubois and Martin	....	6,500	700	7,200	9,000	1.25	236	21
Fountain	65,055	7,300	300	72,655	86,100	1.19	208	156
Gibson	81,641	13,893	3,788	99,322	105,687	1.06	208	198
Greene	2,353,752	50,563	54,350	2,458,665	2,591,385	1.05	116	6,278
Knox	249,764	36,774	6,942	293,480	278,547	.95	175	583
Parke	699,396	17,582	33,336	750,314	1,032,811	1.38	157	2,152
Perry	4,113	12,715	190	17,018	22,908	1.35	183	49
Pike	412,033	31,666	8,697	452,396	444,159	.98	149	1,044
Spencer	3,745	13,190	....	16,935	21,195	1.25	160	46
Sullivan	2,460,302	54,749	56,767	2,571,818	2,595,559	1.01	156	4,136
Vanderburg	90,355	201,165	8,592	300,112	337,479	1.12	256	431
Vermilion	1,241,268	35,600	25,799	1,302,667	1,166,630	.90	214	1,811
Vigo	2,030,876	83,855	74,872	2,189,603	2,172,040	.99	160	4,318
Warren	....	7,125	215	7,340	14,990	2.04	205	29
Warrick	383,112	54,014	10,450	447,576	371,474	.83	202	501
Small mines	....	25,148	....	25,148	32,189	1.28	....	....
Total	10,835,345	732,856	327,051	11,895,252	12,492,255	1.05	151	25,323

The following table shows the coal production of Indiana, by counties, during the last five years, with the increases and decreases in 1905 as compared with 1904:

Coal production of Indiana, 1901–1905, by counties.

[Short tons.]

County.	1901.	1902.	1903.	1904.	1905.	Increase or decrease, 1905.
Clay	1,080,164	1,315,046	1,242,958	960,094	781,574	− 178,520
Daviess	[a] 238,699	234,983	183,692	143,877	101,429	− 42,448
Dubois	....	10,094	[a] 8,546	[a] 13,833	[a] 7,200	− 6,633
Fountain	34,826	17,099	18,660	41,452	72,655	+ 31,203
Gibson	116,526	105,468	81,946	98,257	99,322	+ 1,065
Greene	944,621	1,663,785	2,303,512	2,440,420	2,458,665	+ 18,245
Knox	94,579	119,225	177,046	173,406	293,480	+ 120,074
Parke	631,032	1,155,457	989,983	924,001	750,314	− 173,687
Perry	16,822	21,577	24,941	26,218	17,018	− 9,200
Pike	269,268	510,017	505,564	408,391	452,396	+ 44,005
Spencer	18,885	16,274	19,948	17,511	16,935	− 576
Sullivan	910,725	1,268,945	1,788,358	2,061,212	2,571,818	+ 510,606
Vanderburg	193,716	218,112	241,088	258,254	300,112	+ 41,858
Vermilion	684,253	718,102	915,171	1,068,427	1,302,667	+ 234,240
Vigo	1,362,041	1,652,798	1,826,393	1,756,250	2,189,603	+ 433,353
Warren	....	3,380	5,250	6,545	7,340	+ 795
Warrick	286,068	416,062	435,797	416,311	447,576	+ 31,265
Small mines	36,000	([b])	25,839	27,730	25,148	− 2,582
Total	6,918,225	9,446,424	10,794,692	10,842,189	11,895,252	+1,053,063
Total value	$7,017,143	$10,399,660	$13,244,817	$12,004,300	$12,492,255	+ $487,955

[a] Includes Martin County. [b] Included in county distribution.

The eastern edge of the eastern interior coal field underlies the southwest portion of Indiana, the total area in the State embracing 6,500 square miles and underlying 26 different counties, in 14 of which at present coal is produced on a commercial scale. All of the coal produced in Indiana is classed as bituminous coal. The coal along the eastern edge of the field is known as block or semiblock coal. It is a very pure, dry, noncaking coal, and derives its name from the almost perfectly rectangular blocks into which it breaks, because of the pronounced cleavage planes which intersect each other nearly at right angles. The rest of the coal, distinguished locally as "bituminous," is classed as coking and gas coal, though it is not of sufficiently high grade to compete for those uses with the high-grade coking and gas coals from the East. As a steam coal it competes successfully with the Appalachian coals where the freight rates are slightly in its favor. Cannel coal is successfully mined at one or two points.

Coal has been found at at least 20 different horizons, and as many as 17 beds have been passed through in a single drilling in a vertical distance of 800 feet. Most of these are thin, but beds of sufficient thickness to be worked are found at 8 different horizons. At present the commercial coal is coming from 6 of these. The lower coals which outcrop along the outer or eastern edge of the basin, the block coals mentioned above, occur in basins of from a few acres up, the coal being often 5 feet thick in the center of the basin and thinning to a few inches on the edges. The basins are usually connected and occur at distinct horizons, so that at any horizon the coals of the different basins show the same characteristics of roof, floor, partings, and character of coal. The coal in the block-coal field runs from 2 to 5 feet in thickness, averaging about 3 feet 6 inches. The upper or so-called "bituminous" beds show remarkable persistency over large areas. In many cases the different beds have striking peculiarities that differentiate them at once and allow of their tracing with certainty over several thousand square miles. The horizons of the principal coals are believed to have been continuously traced entirely across the portion of the field in this State. The upper coals range from 3 to 10 feet in thickness, and the majority of the mines have coal 5 or more feet in thickness, over 26 of the large mines having coal 7 or more feet thick. Over 90 per cent of the coals being mined have a clay floor and a still larger percentage have a shale roof. Taking the coal field as a whole, there are considerable areas which do not contain any workable coal; on the other hand, a large part of the field is underlain by more than one workable bed. A number of mines work as high as 3 beds, sometimes all at once, sometimes in succession. Parts of the field are underlain by nearly or quite 20 feet of workable coal.

Nearly all of the commercial mines reach the coal by shafts at depths of from 50 to 450 feet, though there are a few slope mines and still fewer drift mines. As a whole, the mines are well equipped with modern machinery, including mining machines, in which the electric chain machines are in the large majority, electric motors, self-dumping cages, shaking screens, box-car loaders, etc.

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, 1840-1905.

[Short tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1840 [a]	9,682	1862	150,000	1884	2,260,000
1841	10,000	1863	200,000	1885	2,375,000
1842	18,000	1864	250,000	1886	3,000,000
1843	25,000	1865	280,000	1887	3,217,711
1844	30,000	1866	320,000	1888	3,140,979
1845	35,000	1867	350,000	1889	2,845,057
1846	40,000	1868	375,000	1890	3,305,737
1847	45,000	1869	400,000	1891	2,973,474
1848	50,000	1870 [a]	437,870	1892	3,345,174
1849	56,000	1871	600,000	1893	3,791,851
1850	60,000	1872	896,000	1894	3,423,921
1851	60,000	1873	1,000,000	1895	3,995,892
1852	75,000	1874	812,000	1896	3,905,779
1853	75,000	1875	800,000	1897	4,151,169
1854	80,000	1876	950,000	1898	4,920,743
1855	80,000	1877	1,000,000	1899	6,006,523
1856	85,000	1878	1,000,000	1900	6,484,086
1857	85,000	1879	1,196,490	1901	6,918,225
1858	87,000	1880 [a]	1,454,327	1902	9,446,424
1859	95,000	1881	1,984,120	1903	10,794,692
1860 [a]	101,280	1882	1,976,470	1904	10,934,379
1861	128,000	1883	2,560,000	1905	11,895,253

[a] United States census, fiscal year.

RESULTS OF TESTS OF INDIANA COALS.

The more important features of the results of tests made on Indiana coals at the Geological Survey coal-testing plant[a] at St. Louis, Mo., are briefly summarized below. For more detailed reports see Professional Paper No. 48 and Bulletin No. 290 of the United States Geological Survey.

Indiana No. 1.—Operator, J. Woolley Coal Company. Mine, Mildred, at Mildred, Sullivan County. Seam, No. 6. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate	Moisture	13.25	11.50	11.40
	Volatile matter	35.81	35.02	33.81
	Fixed carbon	41.78	43.86	41.39
	Ash	9.16	9.62	13.40
Ultimate	Sulphur	1.87	.96	2.50
	Hydrogen			5.37
	Carbon			60.34
	Nitrogen			1.18
	Oxygen			17.21
Calorific value determined:				
	Calories	6,311		6,145
	British thermal units	11,360		11,061

[a] For brief description of the equipment used in these tests see page 6.

Boiler test: Water evaporated by 1 pound of dry coal, washed, at and from a temperature of 212° F., 8.45 pounds; dry coal consumed per electrical horsepower per hour, 4.13 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.93 pounds.

Coking test: A charge of 8,000 pounds of crushed and washed coal burned 40 hours produced 3,473 pounds of fair coke, brittle and rather high in sulphur.

Washing test: Washing in a modified Stewart jig reduced the ash and the sulphur content, but too much coal went with the refuse for commercial success.

Briquetting test: By using 7 per cent of suitable soft pitch good briquets can be made.

Indiana No. 2.—Operator, T. D. Scales Coal Company. Mine, Electric, at Boonville, Warrick County. Seam No. 5. Kind of coal, bituminous run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	9.28	10.32	9.62
	Volatile matter	39.40	38.08	36.14
	Fixed carbon	41.98	43.05	41.22
	Ash	9.34	8.55	13.02
Ultimate.	Sulphur	4.44	3.51	4.43
	Hydrogen			5.33
	Carbon			60.70
	Nitrogen			1.20
	Oxygen			15.32
Calorific value determined:				
	Calories	6,555		6,179
	British thermal units	11,799		11,122

Boiler test: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 8.02 pounds; dry coal consumed per electrical horsepower per hour, 4.35 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.36 pounds.

Briquetting test: Briquets in every way satisfactory were obtained by using 7 per cent of a soft pitch that is a by-product of the manufacture of gas from heavy petroleum.

Indiana No. 3.—Operator, J. Woolley Coal Company. Mine, No. 3, near Boonville, Warrick County. Kind of coal, bituminous, slack and nut.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	11.28	11.10	13.18
	Volatile matter	38.04	37.04	31.92
	Fixed carbon	43.05	42.18	39.27
	Ash	7.63	9.68	15.63
Ultimate.	Sulphur	3.58	4.33	4.79
	Hydrogen			5.36
	Carbon			54.52
	Nitrogen			1.08
	Oxygen			18.62
Calorific value determined:				
	Calories	6,551		5,572
	British thermal units	11,792		10,030

Boiler test: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 8.11 pounds; dry coal consumed per electrical horsepower per hour, 4.30 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.73 pounds.

Coking test: Raw coal burned twenty-four hours produced no coke.

Washing test: Coal crushed to 2 inches; modified Stewart jig used; raw coal, ash 15.63, sulphur 4.79; washed coal, ash 8.61, sulphur 3.25.

Indiana No. 4.—Operator, Consolidated Indiana Coal Company. Mine, No. 29, at Star City, Sullivan County. Kind of coal, bituminous, screenings, through 1¼-inch.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	14.86	13.37	13.99
	Volatile matter	31.65	35.06	29.40
	Fixed carbon	46.14	44.15	42.29
	Ash	7.35	7.42	14.32
Ultimate.	Sulphur	2.26	2.10	2.31
	Hydrogen			5.36
	Carbon			57.18
	Nitrogen			1.11
	Oxygen			19.72
Calorific value determined:				
	Calories	6,291		5,732
	British thermal units	11,324		10,318

Boiler test, raw coal: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 7.74 pounds; dry coal consumed per electrical horsepower per hour, 4.51 pounds. With washed coal: Water evaporated, 8.86 pounds; dry coal consumed per electrical horsepower per hour, 3.94 pounds.

Coking test: Raw coal burned sixty-two hours yielded medium coke, light gray, and high in ash and sulphur; washed coal gave coke of better color, but containing 2.06 per cent sulphur.

Indiana No. 5.—Operator, Consolidated Indiana Coal Company. Mine, No. 33, at Hymera, Sullivan County. Kind of coal, bituminous run-of-mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	12.14	12.17	12.03
	Volatile matter	35.17	35.53	35.65
	Fixed carbon	43.73	43.14	41.44
	Ash	8.96	9.16	10.88
Ultimate.	Sulphur	3.54	4.66	4.27
	Hydrogen			5.50
	Carbon			60.73
	Nitrogen			1.08
	Oxygen			17.54
Calorific value determined:				
	Calories	6,398		6,218
	British thermal units	11,516		11,192

Boiler tests: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 8.24, 8.35, and 8.13 pounds; dry coal consumed per electrical horsepower per hour, 4.24, 4.18, and 4.30 pounds.

Producer-gas tests: Dry coal consumed per electrical horsepower per hour, 1.93 and 1.35 pounds.

Coking test: Crushed raw coal burned 49 hours, gave 54.40 per cent good, strong, silvery coke, high in ash and sulphur, 17.41 and 4.21 per cent, respectively.

Indiana No. 6.—Operator, Consolidated Indiana Coal Company. Mine, No. 34, at Hymera, Sullivan County. Kind of coal. bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	10.45	9.22	10.80
	Volatile matter	38.62	37.76	36.09
	Fixed carbon	41.35	41.85	40.49
	Ash	9.58	11.17	12.62
Ultimate.	Sulphur	4.04	3.94	4.39
	Hydrogen	....	....	5.46
	Carbon	....	....	60.88
	Nitrogen	....	....	1.13
	Oxygen	....	....	15.52
Calorific value determined:				
	Calories	6,525	....	6,214
	British thermal units	11,745	....	11,185

Boiler test, raw coal: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 8.16 pounds; dry coal consumed per electrical horsepower per hour, 4.28 pounds. Washed coal: Water evaporated, 8.06 pounds; dry coal consumed per electrical horsepower per hour, 4.33 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.73 pounds.

Coking test: Crushed and washed coal burned 49 hours yielded 53.34 per cent of good light-gray silvery coke, high in ash and sulphur.

Washing test: Coal crushed to 2 inches, modified Stewart jig used; raw coal, ash 12.62 per cent, sulphur 4.39 per cent; washed coal, ash 9.83, sulphur 3.49

Indiana, No. 7.—Operator, S. W. Little Coal Company. Mine, Little's, at Littles, Pike County. Kind of coal, bituminous; over 1⅜-inch screen (lump), through 1⅜-inch screen (screenings).

Chemical analyses.

		Mine samples.		Car sample, lump.	Car sample, screenings.
Proximate.	Moisture	10.18	9.99	8.90	11.12
	Volatile matter	38.86	37.86	38.52	36.98
	Fixed carbon	42.84	44.18	43.37	42.55
	Ash	8.12	7.97	9.21	9.35
Ultimate.	Sulphur	3.96	3.25	3.74	3.78
	Hydrogen	....	....	5.61	5.63
	Carbon	....	....	65.54	63.01
	Nitrogen	....	....	1.20	1.13
	Oxygen	....	....	14.70	17.10
Calorific value determined:					
	Calories	6,767	....	6,671	6,416
	British thermal units	12,181	....	12,008	11,549

Boiler test, lump, egg, and nut coal: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 8.72 pounds; dry coal consumed per electrical horsepower per hour, 4 pounds. Screenings: Water evaporated 8.02, dry coal consumed per electrical horsepower per hour, 4.35 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.52 pounds.

Coking test: Crushed, lump, nut, and egg coal burned 112 hours gave 57.13 per cent of light gray, silvery, somewhat brittle coke, high in ash and sulphur.

Washing test, lump, nut, and egg crushed to 2 inches, modified Stewart jig used: Slight lowering of ash and sulphur.

Indiana, No. 8.—Operator, Deep Vein Coal Company. Mine, Deep Vein, 2 miles west of Terre Haute, Vigo County. Kind of coal, bituminous; over 1¼-inch screen (lump).

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	10.68	11.13	9.55
Proximate.	Volatile matter	37.17	36.86	36.19
Proximate.	Fixed carbon	39.91	41.80	43.65
Proximate. / Ultimate.	Ash	12.24	10.21	10.61
Ultimate.	Sulphur	4.38	3.76	3.72
Ultimate.	Hydrogen	....	....	5.49
Ultimate.	Carbon	....	....	64.08
Ultimate.	Nitrogen	....	....	1.08
Ultimate.	Oxygen	....	....	15.02
Calorific value determined:				
	Calories	6,256	....	6,533
	British thermal units	11,261	....	11,759

Boiler tests, raw coal: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 8.15, 8.36, and 3.10 pounds; dry coal consumed per electrical horsepower per hour, 4.28, 4.18, and 4.31 pounds. Washed coal; water evaporated, 8.76 pounds; dry coal consumed per electrical horsepower per hour, 3.90 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.46 pounds.

Washing test, coal crushed to 2 inches, modified Stewart jig used: Very slight reduction in sulphur and ash.

Indiana, No. 9.—Operator, Fauvre Coal Company. Mine, Red Bird, at Macksville, Vigo County. Kind of coal, bituminous; over 1¼-inch screen (lump) and run of mine.

Chemical analyses.

		Mine samples.		Car sample, lump.	Car sample, mine run.
Proximate.	Moisture	13.73	14.33	12.82	13.53
Proximate.	Volatile matter	35.54	35.18	34.80	34.80
Proximate.	Fixed carbon	42.08	42.02	42.08	40.91
Proximate. / Ultimate.	Ash	8.65	8.47	10.30	10.76
Ultimate.	Sulphur	3.00	2.70	3.27	3.15
Ultimate.	Hydrogen	....	....	5.66	5.78
Ultimate.	Carbon	....	....	61.16	59.64
Ultimate.	Nitrogen	....	....	1.03	1.06
Ultimate.	Oxygen	....	....	18.58	19.61
Calorific value determined:					
	Calories	6,311	....	6,177	6,082
	British thermal units	11,360	....	11,119	10,948

Boiler test, run of mine coal: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 8.19 pounds; dry coal consumed per electrical horsepower per hour, 4.26 pounds.

Producer-gas test: Dry coal conusmed per electrical horsepower per hour. 1.61 pounds.

Coking test: Two charges of raw coal, burned 90 and 112 hours, and one of washed coal burned 90 hours; none coked entirely to bottom; coke high in ash and sulphur and not improved by washing coal.

Washing test, run of mine crushed to 2 inches, modified Stewart jig used: Raw coal, ash 10.76 per cent, sulphur 3.15 per cent; washed coal, ash 8.14 per cent, sulphur 2.56 per cent.

Indiana, No. 10.—Operator, Parke County Coal Company. Mine, at Rosedale, Parke County. Kind of coal, bituminous; over 1¼-inch screen (lump).

Chemical analyses.

		Mine samples.		Car. sample.
Proximate.	Moisture	11.54	12.26	10.72
Proximate.	Volatile matter	39.49	38.62	39.29
Proximate.	Fixed carbon	39.35	40.80	41.42
Proximate.	Ash	9.62	8.32	8.57
Ultimate.	Ash	9.62	8.32	8.57
Ultimate.	Sulphur	4.41	4.71	3.83
Ultimate.	Hydrogen			5.86
Ultimate.	Carbon			63.48
Ultimate.	Nitrogen			1.16
Ultimate.	Oxygen			17.10
Calorific value determined:				
	Calories	6,475		6,537
	British thermal units	11,655		11,767

Boiler test, washed coal: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 8.17 pounds; dry coal consumed per electrical horsepower per hour, 4.27 pounds.

Washing test, coal crushed to 2 inches, modified Stewart jig used: Practically no improvement in quality.

Indiana, No. 11.—Operator, Island Coal Company. Mine, No. 4, at Dugger, Sullivan County Kind of coal, bituminous; over 1½-inch and 3-inch screens (lump).

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	14.23	12.62	12.15
Proximate.	Volatile matter	33.04	34.92	33.48
Proximate.	Fixed carbon	47.01	45.48	46.23
Proximate.	Ash	5.72	6.98	8.14
Ultimate.	Ash	5.72	6.98	8.14
Ultimate.	Sulphur	.89	2.35	1.41
Ultimate.	Hydrogen			5.46
Ultimate.	Carbon			64.92
Ultimate.	Nitrogen			1.38
Ultimate.	Oxygen			18.69
Calorific value determined:				
	Calories	6,512		6,534
	British thermal units	11,722		11,761

Boiler tests, rocking grate used: Water evaporated by one pound of dry coal, at and from a temperature of 212° F., 8.94, 8.99, and 9.03 pounds; dry coal consumed per electrical horsepower per hour, 3.91, 3.89, and 3.87 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.51 pounds.

Coking test: Crushed raw coal burned 50 hours gave 55 per cent of fine-fingered coke with high ash and sulphur.

INDIAN TERRITORY.

Total production in 1905, 2,924,427 short tons; spot value, $5,145,358.

The unsatisfactory conditions which prevailed in the coal-mining districts of Arkansas during 1904 and 1905, and which have been mentioned in the discussion of the production in that State, were as obviously present in the adjoining fields of Indian Territory. Cheap fuel oil which had been thrown on the markets in enormous quantities by the oil-well developments in southeastern Texas, and which induced many of the railroads to adopt crude petroleum as a locomotive fuel, naturally cut off an equivalent outlet for Arkansas and Indian Territory coals. This restriction of coal markets was so marked that the railroad companies found it necessary to direct a large number of cars used for transporting coal to other producing regions, where they could be kept in active service. In October, 1905, the production of oil in Texas began to decline, and during November and December was about equal to or a little less than the demand. This had the effect of advancing the price of oil at the wells until it almost trebled, jumping from 16 to 42 cents per barrel. Consumers then turned again to coal, and the closing months of 1905 found Arkansas and Indian Territory operators well supplied with orders; but in the meantime, in addition to the lack of cars, there was by this time a scarcity of labor, miners in many cases having sought other fields of employment. As a result of these untoward circumstances the production of coal in both Arkansas and the Territory showed decreases in both 1904 and 1905, those in the Territory being the more notable.

Comparing the output of the Territory in 1905 with that in 1904, it is seen that there was a decrease of 122,112 short tons, or 4 per cent, while as compared with 1903 the production fell off 592,961 short tons, or nearly 17 per cent. The loss in value was even more pronounced, for, with a decline in the average price per ton from $1.82 in 1903 and 1904 to $1.76 in 1905, the total value in 1905 shows a decrease of $386,708, or 7 per cent, as compared with 1904, and of $1,241,105, or nearly 20 per cent, as compared with 1903.

The year 1906 opened with much better prospects for the coal-mining industry of the southwestern field generally, and it has been stated that the mines could have given employment in the earlier months of the year to 4,000 more men than were employed at that time.

The total number of men employed in the mines of Indian Territory in 1905 was 7,712, who worked an average of 188 days, against 8,487 men for 199 days in 1904. From this it appears that the average output per man in 1905 was 379.2 tons, against 359.9 tons in 1904. The average daily production per man was 2.02 in 1905 and 1.8 tons in 1904. Practically all of the mines are operated 8 hours per day, 98 per cent of the men employed having been reported as working 8 hours in 1905. There has been a steady decline in the use of mining machines since 1899, when over a quarter of a million tons, or about 17 per cent of the total production of the Territory, was undercut by machines. In 1905 the machine-mined product amounted to 40,203 tons, or less than 1.4 per cent of the total.

Labor troubles in the coal mines of Indian Territory were of insignificance in 1905. Strikes occurred in only four mines, and in one instance, where 185 men were involved, work was suspended for but one day. The largest strike lasted 20 days and involved 90 men. In all, 397 men were idle for an average of 9 days. The casualty record for the Territory, as reported by Mr. William Cameron, Territorial mine inspector, for the fiscal year ended June 30, 1905, shows that there were 81 accidents during that year. There were 40 men killed and 59 injured. Twenty-seven wives were made widows and 63 children fatherless.

The statistics of production in Indian Territory for the last five years, with the distribution of the product for consumption, are given in the following table:

Distribution of the coal product of Indian Territory, 1901–1905.

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.*				
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
1905.......	2,707,377	38,898	106,547	71,605	2,924,427	5,145,358	1.76	188	7,712

The coal-bearing rocks of Indian Territory form a part of the western interior coal field. They extend from Indian Territory into Kansas on the north and into Arkansas on the east. Within the Territory this field has an approximate area of 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 total area underlain by workable coal is estimated to be about 14,000 square miles.

At present the entire production is from the Cherokee, Creek, and Choctaw nations, the last named contributing by far the largest portion.

The coal-bearing rocks of Indian Territory belong to the Pennsylvania series of the Carboniferous. The coals, of which there are ten or more beds, vary from a medium low on the one hand to high-grade bituminous, approaching semianthracite, on the other. Some of the high-grade bituminous varieties possess coking qualities. Several hundred ovens are in operation in the eastern and western parts of the Choctaw field. Much of the slack that is produced is washed and turned into coke.

The greater portion of the developments in Indian Territory has been in the Choctaw Nation accessible to the Missouri, Kansas and Texas, the St. Louis and San Francisco, and the Kansas City Southern railroads, that cross the Territory north and south, and to the Choctaw, Oklahoma and Gulf and the Midland Valley roads, that cross it from east to west.

The Tenth United States Census (1880) contains the first published record of the production of coal in 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, 1880–1905.

[Short tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1880 [a]	120,947	1889	752,832	1898	1,381,466
1881	150,000	1890	869,229	1899	1,537,427
1882	200,000	1891	1,091,032	1900	1,922,298
1883	350,000	1892	1,192,721	1901	2,421,781
1884	425,000	1893	1,252,110	1902	2,820,666
1885	500,000	1894	969,606	1903	3,517,388
1886	534,580	1895	1,211,185	1904	3,046,539
1887	685,911	1896	1,366,646	1905	2,924,427
1888	761,986	1897	1,336,380		

[a] United States census, fiscal year.

RESULTS OF TESTS OF INDIAN TERRITORY COALS.

The more important features of the results of tests made on Indian Territory coals at the Geological Survey coal testing plant[a] at St. Louis, Mo., are briefly summarized below. For more detailed reports see Professional Paper No. 48 and Bulletin No. 290 of the United States Geological Survey.

Indian Territory No. 1.—Operator, Whitehead Coal and Mining Company. Mine, No. 1, at Henryetta, Creek Nation. Seam, Henryetta. Kind of coal, bituminous, over 1¾-inch screen.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	8.87	6.77	7.04
	Volatile matter	34.82	36.25	34.55
	Fixed carbon	47.68	51.30	48.40
	Ash	8.63	5.68	10.01
Ultimate.	Sulphur	1.62	1.36	1.92
	Hydrogen			5.34
	Carbon			67.55
	Nitrogen			1.25
	Oxygen			13.93
Calorific value determined:				
	Calories	6,720		6,779
	British thermal units	12,096		12,202

Boiler test: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 8.64 pounds; dry coal consumed, per electrical horsepower per hour, 4.04 pounds.

Producer-gas test: Dry coal consumed, per electrical horsepower per hour, 1.83 pounds.

Coking test: Unwashed coal showed no tendency to coke in a beehive oven.

Indian Territory No. 2.—Operator, Rock Island Coal Company. Mine, No. 8, at Hartshorne, Choctaw Nation. Seam, Hartshorne. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	1.46	1.30	4.45
	Volatile matter	39.04	38.90	36.15
	Fixed carbon	53.10	52.15	48.40
	Ash	6.40	7.65	11.00
Ultimate.	Sulphur	1.38	1.58	1.52
	Hydrogen			5.17
	Carbon			69.49
	Nitrogen			1.67
	Oxygen			11.15
Calorific value determined:				
	Calories	7,800		7,004
	British thermal units	14,040		12,607

Boiler test: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 8.42 pounds; dry coal consumed per electrical horsepower per hour, 4.15 pounds.

Coking test: Washed and unwashed coal yielded coke; unwashed coal burned sixty-six hours produced a soft coke, but containing 1.5 per cent sulphur. Washed coal yielded hard coke with good ring and containing 1.75 per cent sulphur.

Washing test: An ash content of 9.99 per cent was reduced to 6.33 per cent by washing.

Briquetting test: Coal will probably require more than usual pressure to give satisfactory briquets.

[a] For brief description of the equipment used in these tests see p. 6.

Indian Territory No. 3.—Operator, D. Edwards & Son. Mine, No. 6, at Edwards, Creek Nation. Seam, McAlester. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	2.97	2.93	4.61
	Volatile matter	40.43	39.02	37.00
	Fixed carbon	48.22	47.75	47.25
	Ash	8.38	10.30	11.14
Ultimate.	Sulphur	3.05	3.73	3.63
	Hydrogen			4.92
	Carbon			67.37
	Nitrogen			1.48
	Oxygen			11.46
Calorific value determined:				
	Calories		6,995	6,844
	British thermal units		12,591	12,319

Boiler test: Water evaporated by 1 pound of dry coal. at and from a temperature of 212° F., 8.17 pounds; dry coal consumed per electrical horsepower per hour, 4.27 pounds.

Coking test: Neither unwashed nor washed coal would coke in a beehive oven.

Washing test: Washing did not materially reduce sulphur or ash.

Briquetting test: Can be briquetted with 6 per cent of suitable soft pitch.

Indian Territory No. 4.—Operator, Western Coal and Mining Company. Mine No. 5, one-half mile north of Lehigh, Choctaw Nation. Seam, Lehigh. Kind of coal, bituminous, over 1-inch screen.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	5.29	6.50	6.24
	Volatile matter	37.54	39.01	37.26
	Fixed carbon	45.04	45.18	43.29
	Ash	12.13	9.31	13.21
Ultimate.	Sulphur	3.77	3.67	3.96
	Hydrogen			4.93
	Carbon			62.34
	Nitrogen			1.36
	Oxygen			14.20
Calorific value determined:				
	Calories		6,579	6,238
	British thermal units		11,842	11,228

Boiler test: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 7.53 pounds; dry coal consumed per electrical horsepower per hour, 4.64 pounds.

Producer-gas test: Dry coal consmued per electrical horsepower per hour, 1.43 pounds.

Indian Territory No. 5.—Operator, Western Coal and Mining Company. Mine, No. 7, at Lehigh, Choctaw Nation. Seam, Lehigh. Kind of coal, bituminous, mixed through ¼ and ⅛ inch screen (slack and pea).

Chemical analysis.

		Car sample.
Proximate.	Moisture	8.29
	Volatile matter	30.61
	Fixed carbon	36.05
	Ash	25.05
Ultimate.	Sulphur	3.95
	Hydrogen	4.37
	Carbon	50.98
	Nitrogen	1.19
	Oxygen	14.46
Calorific value determined:		
	Calories	5,061
	British thermal units	9,110

Coking test: Washed coal burned 65 hours yielded some small pieces of light, soft coke. General conclusion regarding Indian Territory coals was that when properly washed they will produce coke, but not of a character suitable for iron smelting, as the sulphur is too intimately combined to be removed by washing.

Washing test: Ash reduced from 25.05 to 8.14 per cent and sulphur from 3.95 to 2.90 per cent.

Indian Territory, No. 6.—Operator, Southwestern Development Company. Mine, at Coalgate, Choctaw Nation. Seam, McAlester. Kind of coal, bituminous slack.

Chemical analysis.

		Car sample.
Proximate	Moisture	8.03
	Volatile matter	31.28
	Fixed carbon	41.40
	Ash	19.29
Sulphur		3.20

Briquetting test: This very dirty slack was briquetted with several binders. The best briquets, hard, compact, but somewhat earthy, were from using 8 per cent of a soft pitch obtained in making gas from heavy petroleum.

IOWA.

Total production in 1905, 6,798,609 short tons; spot value, $10,586,381.

Coal production in Iowa has exhibited a gradual but uninterrupted increase each year since 1896, the output in 1905, as in each of the six preceding years, being the banner year up to that time. Compared with 1904, when the production amounted to 6,519,933 short tons, valued at $10,504,406, the production in 1905 indicates an increase of 278,676 short tons, or 4 per cent in quantity, but of only $81,975, or a little over 0.8 per cent, in value. As in a number of States in the Mississippi Valley region, the amount of coal produced in Iowa during 1905 was in excess of the market requirements and prices generally declined. The average price for the entire State in 1905 was $1.56 per short ton, as compared with $1.61 in 1904, and $1.65 in 1903.

The number of men employed in the coal mines of Iowa decreased from 15,629 in 1904 to 15,113 in 1905. The average working time was the same, 209 days, in both years. In 1903 there were 14,162 men employed for an average of 226 days. From these figures it appears that the decline in price has been in part, at least, made up by an increase in the individual producing efficiency of the mine workers. In 1905 the average daily production per man was 2.15 tons against 1.96 tons in 1904, and 2 tons in 1903. The production per year per man was 449.9 tons in 1905, 417.2 tons in

1904, and 453.3 tons in 1903, the larger average in 1903 being partly due to the greater number of days worked.

The use of mining machines in Iowa does not exert any material influence on the production, the total machine-mined tonnage in 1905 being less than 3 per cent of the total output. There are only five mines in which machines were used in 1905, and the number of machines in use was 32, by the use of which 186,224 tons were mined. In 1904 there were 39 machines in use, and the machine-mined product amounted to 175,742 short tons.

Comparatively little trouble was experienced in the way of strikes during 1905. There were only 12 mines in which strikes were reported. These 12 mines employed an aggregate of 1,774 men; but all the stoppages were of short duration, ranging from 2 to 18 days, and averaging only 6 days' time lost for each of the men on strike.

Of the total number of men employed in the coal mines of Iowa 13,569, distributed among 186 mines, worked on the basis of an eight-hour day. Five mines, employing a total of 56 men, worked 9 hours, and 3 mines, employing 22 men, worked 10 hours. Eight mines, having a total of 168 men, reported 6 or 7 hours to the day. Eighteen mines, employing 1,298 men, did not report the number of hours worked per day.

Iowa had the lowest death rate of all the coal-producing States in 1905. The total number of men killed during the year was 24, the rate per thousand employees being 1.36. The number of tons mined for each life lost was 283,584. The nonfatal accidents numbered 100.

The statistics of production in 1904 and 1905, by counties, with the distribution of the product for consumption, are shown in the following tables

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

Coal production of Iowa in 1905, 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	....	13,046	25	13,071	$29,805	$2.28	149	87
Appanoose	836,949	37,318	9,981	884,248	1,590,949	1.80	164	2,788
Boone	264,269	18,975	9,415	292,659	536,115	1.83	196	821
Greene	2,500	15,902	1,656	20,058	38,428	1.92	170	58
Guthrie	2,184	17,229	60	19,473	42,305	2.17	169	72
Jasper	277,570	16,334	12,260	306,164	471,629	1.54	240	701
Keokuk	700	14,320	1,440	16,460	27,435	1.67	198	29
Mahaska	658,571	35,347	21,027	714,945	997,695	1.40	213	1,363
Marion	304,471	24,909	9,432	338,812	463,968	1.37	222	700
Monroe	1,994,567	183,382	47,728	2,225,677	3,076,009	1.38	236	3,871
Polk	964,094	211,308	34,918	1,210,320	2,025,723	1.67	237	2,453
Scott	....	6,222	....	6,222	12,444	2.00	130	29
Taylor	11,547	10,783	15	22,345	50,112	2.24	226	84
Van Buren	4,180	2,007	5	6,192	12,947	2.09	102	30
Wapello	236,251	62,614	4,495	303,360	464,537	1.53	204	694
Warren	4,352	5,524	....	9,876	21,252	2.16	199	36
Wayne	93,004	19,100	445	112,549	212,752	1.89	213	389
Webster	90,782	19,284	3,327	113,393	220,738	1.95	206	364
Other counties [a] and small mines	128,065	45,599	9,121	182,785	291,538	1.59	200	544
Total	5,874,056	759,203	165,350	6,798,609	10,586,381	1.56	209	15,113

[a] Dallas, Jefferson, Lucas, and Page.

The production by counties during the last five years, with the increases and decreases in 1905 as compared with 1904, is shown in the following table:

Coal production of Iowa, 1901–1905, by counties.

[Short tons.]

County.	1901.	1902.	1903.	1904.	1905.	Increase or decrease, 1905.
Adams	....	19,751	22,570	12,970	13,071	+ 101
Appanoose	721,997	900,337	893,021	872,920	884,248	+ 11,328
Boone	254,054	254,324	291,321	285,157	292,659	+ 7,502
Dallas	16,987	18,845	15,467	13,086	5,000	− 8,086
Davis	....	3,953	3,160	....	....	....
Greene	18,810	11,573	14,971	27,704	20,058	− 7,646
Jasper	184,670	233,440	270,804	258,098	306,164	+ 48,066
Jefferson	....	10,610	6,844	9,810	3,379	− 6,431
Keokuk	308,193	106,103	62,875	41,512	16,460	− 25,052
Lucas	221,058	246,400	295,554	189,895	147,093	− 42,802
Mahaska	929,110	723,567	698,166	675,113	714,945	+ 39,832
Marion	145,981	315,425	324,859	314,908	338,812	+ 23,904
Monroe	1,038,332	1,406,905	1,768,054	1,987,450	2,225,677	+238,227
Page	....	10,070	16,343	18,302	14,013	− 4,289
Polk	1,025,014	1,023,860	1,032,164	1,130,668	1,210,320	+ 79,652
Scott	....	10,358	12,653	9,930	6,222	− 3,708
Taylor	23,499	14,207	16,933	16,273	22,345	+ 6,072
Van Buren	12,572	14,816	13,561	8,005	6,192	− 1,813
Wapello	312,174	340,762	382,398	379,560	303,360	− 76,200
Warren	14,661	20,127	12,760	11,290	9,876	− 1,414
Wayne	56,578	65,374	105,170	98,879	112,549	+ 13,670
Webster	146,020	149,615	138,296	134,538	113,393	− 21,145
Other counties and small mines	187,789	4,344	21,867	23,865	32,773	+ 8,908
Total	5,617,499	5,904,766	6,419,811	6,519,933	6,798,609	+278,676
Total value	$7,822,805	$8,660,287	$10,563,910	$10,504,406	$10,586,381	+$81,975

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 Pennsylvania 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-bearing rocks, or Missouri 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 rocks as a whole dip from 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 probably ranks second among the States west of the Mississippi River in order of priority as a coal producer. At the time of taking the United States census for 1840, Iowa and Missouri were the only States west of the river in which any coal production was reported. Missouri, however, was credited with an output of nearly 10,000 tons, while Iowa's production was given at 400 tons. It is probable, therefore, that the first mine opened in Missouri antedated Iowa's initial production. Since 1840 the production in Iowa has been as follows:

Production of coal in Iowa, 1840–1905.

[Short tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1840 [a]	400	1862	53,000	1884	4,370,566
1841	500	1863	57,000	1885	4,012,575
1842	750	1864	63,000	1886	4,315,779
1843	1,000	1865	69,574	1887	4,473,828
1844	2,500	1866	99,320	1888	4,952,440
1845	5,000	1867	150,000	1889	4,095,358
1846	6,500	1868	241,453	1890	4,021,739
1847	8,000	1869	295,105	1891	3,825,495
1848	10,000	1870 [a]	263,487	1892	3,918,491
1849	12,500	1871	300,000	1893	3,972,229
1850	15,000	1872	336,000	1894	3,967,253
1851	18,000	1873	392,000	1895	4,156,074
1852	20,000	1874	799,936	1896	3,954,028
1853	23,000	1875	1,231,547	1897	4,611,865
1854	25,000	1876	1,250,000	1898	4,618,842
1855	28,000	1877	1,300,000	1899	5,177,479
1856	30,000	1878	1,350,000	1900	5,202,939
1857	33,000	1879	1,400,000	1901	5,617,499
1858	37,500	1880	1,461,116	1902	5,904,766
1859	42,000	1881	1,960,000	1903	6,419,811
1860 [a]	41,920	1882	3,920,000	1904	6,519,933
1861	50,000	1883	4,457,540	1905	6,798,609

[a] United States census, fiscal year.

RESULTS OF TESTS OF IOWA COALS.

The more important features of the results of tests made on Iowa coals at the Geological Survey coal-testing plant [a] at St. Louis, Mo., are briefly summarized below. For more detailed reports see Professional Paper No. 48 and Bulletin No. 290 of the United States Geological Survey.

[a] For brief description of the equipment used in these tests see page 6.

Iowa, No. 1.—Operator, Anchor Coal Company. Mine, No. 2, at Laddsdale, Davis County. Seam, middle bed. Kind of coal, bituminous, over 1½-inch screen.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	11.35	12.07	8.24
Proximate.	Volatile matter	38.65	37.28	30.74
Proximate.	Fixed carbon	39.49	38.32	45.02
Proximate.	Ash	10.51	12.33	16.00
Ultimate.	Sulphur	4.72	4.99	5.03
Ultimate.	Hydrogen			4.81
Ultimate.	Carbon			59.82
Ultimate.	Nitrogen			0.94
Ultimate.	Oxygen			13.40
Calorific value determined:				
	Calories	6,303		6,126
	British thermal units	11,345		11,027

Boiler test: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 7.24 pounds; dry coal consumed per electrical horsepower per hour, 4.82 pounds.

Coking test: Washed coal yielded about 51 per cent of brittle coke high in sulphur and ash.

Washing test: Some improvement effected by washing; sulphur reduced from 5.03 to 4.61 per cent and ash from 16 to 10.25 per cent.

Iowa, No. 2.—Operator, Mammoth Vein Coal Company. Mine, No. 5, in Liberty Township, Marion County. Seam, big vein. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	15.65	15.50	14.21
Proximate.	Volatile matter	36.87	36.94	33.17
Proximate.	Fixed carbon	35.84	38.37	37.40
Proximate.	Ash	11.64	9.19	15.22
Ultimate.	Sulphur	5.10	5.19	4.66
Ultimate.	Hydrogen			5.50
Ultimate.	Carbon			54.08
Ultimate.	Nitrogen			1.31
Ultimate.	Oxygen			19.23
Calorific value determined:				
	Calories	5,716		5,566
	British thermal units	10,289		10,019

Boiler test: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 7.05 pounds; dry coal consumed per electrical horsepower per hour, 4.95 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.73 pounds.

Coking test: Charge of washed coal burned 64 hours yielded 38.6 per cent coke, all in small pieces sintered together and with no bond.

Washing test: Reduction of impurities by washing not great.

Iowa, No. 3.—Operator, Gibson Coal Mining Company. Mine, No. 1, near Altoona, Polk County. Seam, third seam. Kind of coal, bituminous, over 1⅜-inch screen.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	14.42	15.90	13.88
Proximate.	Volatile matter	37.81	37.42	36.94
Proximate.	Fixed carbon	36.78	34.41	35.17
Proximate. / Ultimate.	Ash	10.99	12.37	14.01
Ultimate.	Sulphur	5.89	6.76	6.15
Ultimate.	Hydrogen			5.52
Ultimate.	Carbon			54.68
Ultimate.	Nitrogen			0.84
Ultimate.	Oxygen			18.80
Calorific value determined:				
	Calories	5,911		5,691
	British thermal units	10,640		10,244

Boiler test: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 7.02 pounds; dry coal consumed per electrical horsepower per hour, 4.97 pounds.

Coking test: Yielded fine fingered brittle coke, high in sulphur and ash even after washing.

Washing test: By washing a coke-oven charge the ash, 10.96 per cent, and sulphur, 4.26 per cent, were reduced to 7.14 and 3.59 per cent respectively.

Iowa, No. 4.—Operator, Centerville Block Coal Company. Mine, No. 3, at Centerville, Appanoose County. Seam, Mystic. Kind of coal, bituminous, over 1⅜-inch screen.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	17.13	16.14	14.08
Proximate.	Volatile matter	35.44	34.94	35.59
Proximate.	Fixed carbon	40.36	37.84	39.37
Proximate. / Ultimate.	Ash	7.07	11.08	10.96
Ultimate.	Sulphur	4.00	4.76	4.26
Ultimate.	Hydrogen			5.57
Ultimate.	Carbon			58.49
Ultimate.	Nitrogen			0.90
Ultimate.	Oxygen			19.82
Calorific value determined:				
	Calories	6,073		5,957
	British thermal units	10,931		10,723

Boiler test: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 7.11 pounds; dry coal consumed per electrical horsepower per hour, 4.91 pounds.

Coking test: Gives fine fingered brittle coke high in sulphur and ash.

Washing test: In the lot tested sulphur was reduced by washing from 6.15 to 4.55 per cent and ash from 14.01 to 8.03 per cent.

Briquetting test: Fairly strong briquets, which in burning held together until consumed, were obtained by using 8 per cent of a soft pitch.

Iowa, No. 5.—Operator, Inland Fuel Company. Mine, No. 1, at Chariton, Lucas County. Seam, lower bed. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	18.69	18.59	15.39
	Volatile matter	31.80	34.36	30.49
	Fixed carbon	41.78	39.90	41.49
	Ash	7.73	7.15	12.63
Ultimate.	Sulphur	2.39	3.10	3.19
	Hydrogen			5.74
	Carbon			55.81
	Nitrogen			1.14
	Oxygen			21.49
Calorific value determined:				
	Calories	5,836		5,690
	British thermal units	10,505		10,242

Boiler test: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 7.50 pounds; dry coal consumed per electrical horsepower per hour, 4.66 pounds.

Coking test: Coal does not coke in beehive oven, even after washing.

Washing test: A charge which contained 12.63 per cent ash and 3.19 per cent sulphur before washing contained 7.93 and 2.28 per cent, respectively, after washing. In all the Iowa coals tested during 1904 the sulphur occurred largely in the form of gypsum, making its removal by washing extremely difficult.

KANSAS.

Total production in 1905, 6,423,979 short tons; spot value, $9,350,542.

The coal production of Kansas, like that of Iowa, has increased regularly since 1896, in which year the production was not quite 45 per cent of what it amounted to in 1905. The increase last year over 1904 was only 90,672 short tons, or 1.4 per cent, and this was accompanied by a decline in prices, which resulted in a decrease of $290,229 in value. The average price for the State declined from $1.52 in 1904 to $1.46 in 1905. As in Iowa, however, the decrease in value was in part compensated for by a decrease in the number of men employed, for while it required 12,198 men for an average of 213 days in 1904 to produce 6,333,307 short tons, there were 11,926 men employed for an average of 212 days in the production of 6,423,979 tons in 1905. From this it is found that the average production per man increased from 519.2 tons in 1904 to 538.7 tons in 1905, while the average daily production per man increased from 2.44 tons to 2.54 tons. In 1903 the average daily production per man was 2.49 tons and the average per man for the year 534.6 tons. The use of mining machines in this State does not affect the other results. In 1905 there were three mines which reported operating a total of 10 undercutting machines. The machine-mined product amounted to 19,101 tons. In the preceding year 5 machines produced 10,600 tons.

Labor troubles among the miners in Kansas were negligible in both 1904 and 1905 and had no influence on the production. Strikes in 1905 were reported at nine mines. They varied in duration from 2 to 30 days. The most serious suspension was at the mines of the Home-Riverside Coal Company, at Leavenworth, where 616 men were on strike for 11 days. In all, 1,482 men were idle at various times for an average of 10 days, the total time lost amounting to 14,686 working days, or only a little more than 0.5 per cent of the total time worked.

Coal mining in Kansas, as in other States where the industry has been carried on under agreements with the United Mine Workers of America, is conducted on a basis of 8 hours per day, although a few mines report 9 and 10 hours to the working day.

In 1905 out of a total of 155 mines, employing 11,926 men, 121, employing a total of 11,004 men, worked 8 hours; 6 mines, employing 129 men, worked 9 hours, and 5 mines, having 54 men, worked 10 hours. Five properties, employing 460 men, reported less than 8 hours, and 18 mines, employing 279 men, did not reply to this inquiry

The statistics of production in 1904 and 1905, by counties, with the distribution of the product for consumption, are shown in the following tables:

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.

Coal production of Kansas in 1905, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*				
Cherokee	2,058,254	32,791	41,544	2,132,589	$3,043,795	$1.43	215	3,648
Crawford	3,611,016	57,306	61,631	3,729,953	5,101,268	1.37	212	6,190
Leavenworth	265,106	71,084	12,132	348,322	723,946	2.08	229	1,178
Linn	27,548	2,613	512	30,673	52,047	1.70	155	105
Osage	133,708	23,376	243	157,327	367,023	2.33	174	761
Other counties [a]	1,775	12,770	525	15,070	39,830	2.64	195	44
Small mines		10,045		10,045	22,633	2.25		
Total	6,097,407	209,985	116,587	6,423,979	9,350,542	1.46	212	11,926

[a] Bourbon, Cloud, Franklin, Jewell, and Labette.

The production by counties during the last five years, with the increases and decreases in 1905 as compared with 1904, is shown in the following table:

Coal production of Kansas, 1901–1905.

[Short tons.]

County.	1901.	1902.	1903.	1904.	1905.	Increase or decrease, 1905.
Atchison	3,000	(a)	....	....	....	....
Cherokee	1,550,198	1,849,896	2,062,897	2,378,624	2,132,589	− 246,035
Cloud	....	7,524	2,400	3,000	3,000	....
Crawford	2,708,701	2,881,274	3,132,595	3,399,334	3,729,953	+ 330,619
Franklin	11,460	4,999	4,900	4,740	1,950	− 2,790
Leavenworth	248,476	291,681	382,828	333,419	348,322	+ 14,903
Linn	26,380	29,780	47,617	29,657	30,673	+ 1,016
Osage	222,293	192,781	194,727	171,454	157,327	− 14,127
Other counties and small mines	130,020	8,130	12,012	13,079	20,165	+ 7,086
Total	4,900,528	5,266,065	5,839,976	6,333,307	6,423,979	+ 90,672
Total value	$5,991,599	$6,862,787	$8,871,953	$9,640,771	$9,350,542	−$290,229

a Included in other counties.

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 Pennsylvania 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. Some of the coal mined in this district possesses coking qualities, and a small amount of coke is made from slack coal produced at the mines in the vicinity of Pittsburg. About half of the coal used in coke making is washed before being charged into the ovens. The coke is used by the zinc smelters in and about Pittsburg.

The second district of importance is that adjacent to Leavenworth and Atchison, in the northeastean portion of the State, where, at a depth of 700 to 1,150 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.

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, 1869–1905.

[Short tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1869	36,891	1882	750,000	1895	2,926,870
1870 [a]	32,938	1883	900,000	1896	2,884,801
1871	41,000	1884	1,100,000	1897	3,054,012
1872	44,800	1885	1,212,057	1898	3,406,555
1873	56,000	1886	1,400,000	1899	3,852,267
1874	85,000	1887	1,596,879	1900	4,467,870
1875	150,000	1888	1,850,000	1901	4,900,528
1876	225,000	1889	2,221,043	1902	5,266,065
1877	300,000	1890	2,259,922	1903	5,839,976
1878	375,000	1891	2,716,705	1904	6,333,307
1879	460,000	1892	3,007,276	1905	6,423,979
1880 [a]	771,442	1893	2,652,546		
1881	840,000	1894	3,388,251		

[a] United States Census, fiscal year.

RESULTS OF TESTS OF KANSAS COALS.

The more important features of the results of tests made on Kansas coals at the Geological Survey coal-testing plant [a] at St. Louis, Mo., are briefly summarized below.

For more detailed reports see Professional Paper No. 48 and Bulletin No. 290 of the United States Geological Survey.

Kansas, No. 1.—Operator, Western Coal and Mining Company. Mine, No. 10, at Fleming, Crawford County. Seam, Weir-Pittsburg. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	2.91	3.50	4.99
	Volatile matter	35.81	35.75	32.68
	Fixed carbon	51.73	52.83	49.36
	Ash	9.55	7.92	12.97
Ultimate.	Sulphur	3.79	3.28	4.28
	Hydrogen			4.98
	Carbon			67.34
	Nitrogen			1.08
	Oxygen			9.35
Calorific value determined:				
	Calories	7,193		6,801
	British thermal units	12,947		12,242

Boiler test: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 8.63 pounds; dry coal consumed per electrical horsepower per hour, 4.05 pounds.

Coking test: Unwashed coal will not coke in a beehive oven.

[a] For brief description of the equipment used in these tests see page 6.

Kansas, No. 2.—Operator, Western Coal and Mining Company. Mine, No. 11, at Yale, Crawford County. Seam, Weir-Pittsburg. Kind of coal, bituminous, lump and nut.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	2.44	2.36	4.18
Proximate.	Volatile matter	35.16	34.62	31.23
Proximate.	Fixed carbon	51.80	51.23	46.68
Proximate. / Ultimate.	Ash	10.60	11.79	17.91
Ultimate.	Sulphur	5.63	5.88	6.27
Ultimate.	Hydrogen			4.69
Ultimate.	Carbon			61.88
Ultimate.	Nitrogen			0.92
Ultimate.	Oxygen			8.33

Boiler test: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 8.17 pounds; dry coal consumed per electrical horsepower per hour, 4.28 pounds.

Coking test: Showed no tendency to coke, though burned 159 hours.

Briquetting test: Can be readily made into commercial briquets by using about 7 per cent of suitable soft pitch.

Kansas, No. 3.—Operator, Southern Coal and Mercantile Company. Mine, No. 9, at Scammon, Cherokee County. Seam, Weir-Pittsburg. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	2.01	2.54	3.50
Proximate.	Volatile matter	35.99	35.31	33.80
Proximate.	Fixed carbon	46.85	52.28	51.25
Proximate. / Ultimate.	Ash	15.15	9.87	12.45
Ultimate.	Sulphur	5.27	4.47	5.68
Ultimate.	Hydrogen			4.91
Ultimate.	Carbon			69.07
Ultimate.	Nitrogen			1.20
Ultimate.	Oxygen			6.69
Calorific value determined:				
	Calories		7,411	7,166
	British thermal units		13,340	12,900

Boiler test: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 7.69 pounds; dry coal consumed per electrical horsepower per hour, 4.55 pounds.

Coking test: Unwashed coal coked at top of charge; remainder charred coal and ash.

Kansas, No. 4.—Operator, Atchison Coal Mining Company. Mine, Atchison, 1½ miles below Atchison, Atchison County. Kind of coal, bituminous, lump.

Chemical analysis.

		Car sample.
Proximate.	Moisture	6.95
	Volatile matter	35.70
	Fixed carbon	45.16
	Ash	12.19
Ultimate.	Sulphur	8.04
	Hydrogen	5.25
	Carbon	62.74
	Nitrogen	1.04
	Oxygen	10.74
Calorific value determined:		
	Calories	6,614
	British thermal units	11,905

Boiler test: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 7.75 pounds; dry coal consumed per electrical horsepower per hour, 4.51 pounds.

Coking test: Showed more tendency to coke than any other coal tested from Kansas. Coke hard, brittle, and high in sulphur, but can be used in zinc and lead smelters.

Kansas, No. 5.—Operator, Southwestern Development Company. Mine, No. 11, at West Mineral, Cherokee County. Kind of coal, bituminous, over ⅝-inch perforated screen (engine coal).

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	5.11	5.79	4.10
	Volatile matter	32.60	32.34	31.65
	Fixed carbon	53.39	49.32	53.71
	Ash	8.90	12.55	10.54
Ultimate.	Sulphur	4.34	3.84	3.77
	Hydrogen			5.10
	Carbon			70.25
	Nitrogen			1.06
	Oxygen			9.28
Calorific value determined:				
	Calories	7,181		7,164
	British thermal units	12,926		12,895

Boiler test: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 8.88 pounds; dry coal consumed per electrical horsepower per hour, 3.93 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.50 pounds.

KENTUCKY.

Total production in 1905, 8,432,523 short tons; spot value, $8,385,232.

Each year since 1896 the coal production of Kentucky has shown an uninterrupted increase, until in 1905 the output was two and a half times that of 1896. Compared with 1904, when the production amounted to 7,576,482 short tons, the output in 1905 shows an increase of 856,041 tons, or 11.3 per cent, while the value increased in somewhat less proportion from $7,868,192 to $8,385,232, a gain of $517,040, or 6.6 per cent. In Kentucky, as in most of the more important coal-producing States, particularly in those east of the Mississippi River, the increase in production was accompanied by a decline in price, that for Kentucky falling from $1.04 in 1904 to 99 cents in 1905.

The decline in price in 1905, as in 1904, was partly compensated for in the larger number of tons mined for each employee and in a decided increase in the use of and production by machines. In 1905 a total of 14,685 men were employed in the coal mines of Kentucky, working an average of 200 days and producing an average of 2.87 tons per day and 574 tons for the year, as against 14,235 men, who worked an average of 197 days in 1904, and who produced 2.70 tons each per day and 532.2 tons each during the year. In 1903 the average production per man was 525.2 tons for the year and 2.54 tons for each day, while in 1902 the corresponding figures were respectively 491.5 and 2.35. These figures indicate a steady improvement in productive capacity per employee, and that this was due, in part at least, to the installation of undercutting machinery is shown by the fact that in 1903 there were 308 mining machines employed in the production of 2,843,805 short tons of coal; in 1904 the number of machines was increased to 453 and the machine-mined production to 3,595,513 tons, and in 1905 the number of machines in use was 527, a gain of 74, and the machine-mined coal amounted to 4,409,054 tons, a gain of 813,541 tons. In 1904 the percentage of machine-mined coal to the total product was 47.5, while in 1905 the percentage was 51.4.

A plurality, but not a majority, of the mines of Kentucky report the length of the day worked at 10 hours. Out of a total of 231 mines reporting production in 1905, and which employed an aggregate of 14,685 men, 94 mines, employing 5,995 men, reported 10 hours per day; 52 mines, employing 4,050 men, reported 9 hours; and 50 mines, employing 3,445 men, worked 8 hours. Thirty-five mines, employing 1,195 men, did not report the number of hours per day.

The coal-mining industry of Kentucky was not materially affected by labor troubles during 1905. There were 13 mines in which strikes occurred, and at one of these while 50 men were on strike for 300 days the mine was idle but 1 day. This was at the mine of the Meek Coal Company, in Johnson County. At collieries B and C, of the West Kentucky Coal Company, in Union County, 300 men were idle for 95 days, and at the Strait Creek mine, of the Strait Creek Coal Company, in Carter County, 90 men were idle 93 days. These were responsible for 83 per cent of the total time lost by strikes. Altogether 923 men were idle for an average of 68 days, and the total time lost was a little more than 2 per cent of the time worked. In 1904 strikes occurred at 37 mines, involving 3,781 men who were idle during an average of 39 days.

Mr. C. J. Norwood, chief inspector of mines, reports that there were 36 fatal accidents in the coal mines of Kentucky in 1905. Of these 32 were inside and 4 outside. The majority of fatalities (20 in all) inside the mines were due to falls of roof. There were 14 wives made widows and 22 children left fatherless.

The statistics of production in 1904 and 1905, by counties, with the distribution of the product for consumption, are shown in the following tables:

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	494,164	13,091	7,640	6,767	521,662	$559,859	$1.07	194	1,341
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	1,041
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	6,879,247	423,160	180,970	93,105	7,576,482	7,868,192	1.04	197	14,235

[a] Breathitt, Butler, Caldwell, Clay, Grayson, Greenup, Knott, Lawrence, Letcher, Magoffin, Menifee, Morgan, Owsley, and Pike.

Coal production of Kentucky in 1905, 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	691,578	15,777	14,315	35,743	757,413	$829,496	$1.10	214	1,458
Boyd	46,542	1,762	....	....	48,304	37,260	.77	178	74
Carter	138,135	5,764	1,270	....	145,169	144,448	1.00	201	307
Daviess	....	61,183	597	....	61,780	66,936	1.08	222	115
Hancock	41,167	6,590	60	....	47,817	52,544	1.10	224	85
Henderson	114,608	54,246	6,372	....	175,226	192,159	1.10	172	405
Hopkins and Christian	1,882,619	55,799	63,622	101,441	2,103,481	1,737,964	.83	222	2,336
Johnson	53,140	3,170	1,000	....	57,310	69,192	1.21	194	193
Knox	564,397	5,681	9,308	....	579,386	586,469	1.01	219	952
Laurel	437,668	3,010	5,280	....	445,958	411,948	.92	214	860
Lee	92,097	2,050	450	....	94,597	116,966	1.24	203	167
McLean	105,766	2,151	1,512	....	109,429	96,533	.88	168	190
Morgan	81,201	3,257	596	....	85,054	194,858	2.29	266	285
Muhlenberg	1,021,172	13,429	15,900	....	1,050,501	915,655	.87	175	1,887
Ohio	512,044	12,523	17,760	....	542,327	483,801	.89	179	928
Pike	101,432	6,789	224	....	108,445	92,669	.85	236	157
Pulaski	173,587	5,070	5,662	....	184,319	234,196	1.27	193	434
Union	311,644	47,981	16,672	6,659	382,956	386,635	1 01	165	748
Webster	306,328	29,227	12,262	....	347,817	316,790	.91	181	595
Whitley	753,815	26,440	13,647	....	793,902	1,018,757	1.28	200	1,953
Other counties[a]	188,426	29,382	8,631	....	226,439	299,867	1.32	205	556
Small mines	....	84,893	....	....	84,893	100,089	1.18	....	....
Total	7,617,366	476,174	195,140	143,843	8,432,523	8,385,232	.99	200	14,685

[a] Breathitt, Butler, Caldwell, Clay, Elliott, Greenup, Harlan, Knott, Lawrence, Magoffin, Menifee, Owsley, Rockcastle, and Wayne.

In the following table is presented a statement of the production of coal in Kentucky during the last 5 years, with the increases and decreases in 1905 as compared with the preceding year:

Coal production of Kentucky, 1901–1905, by counties.

[Short tons.]

County.	1901.	1902.	1903.	1904.	1905.	Increase or decrease in 1905.
Bell	333,235	461,768	392,016	521,662	757,413	+ 235,751
Boyd	173,930	242,021	245,491	69,095	48,304	− 20,791
Breathitt and Lee	37,326	60,524	80,301	110,303	126,937	+ 16,634
Butler	18,802	12,868	3,600	1,647	18,199	+ 16,552
Carter	245,526	281,401	265,226	245,030	145,169	− 99,861
Christian, Daviess, and Hancock	97,645	125,708	180,544	185,922	199,363	+ 13,441
Greenup	....	....	3,167	2,742	1,543	− 1,199
Henderson	169,365	158,471	178,871	151,103	175,226	+ 24,123
Hopkins	1,362,299	1,555,084	1,743,721	1,691,675	2,013,715	+ 322,040
Johnson	[a] 37,692	126,473	77,100	41,120	57,310	+ 16,190
Knox	283,706	481,819	543,557	577,778	579,386	+ 1,608
Laurel	315,698	402,997	392,288	380,667	445,958	+ 65,291
Lawrence	46,924	57,387	66,826	69,036	37,481	− 31,555
McLean	17,716	54,568	127,869	117,616	109,429	− 8,187
Muhlenberg	532,840	700,700	798,892	934,048	1,050,501	+ 116,453
Ohio	502,974	541,226	586,072	514,126	542,327	+ 28,201
Pulaski	138,787	159,497	196,287	197,796	184,319	− 13,477
Rockcastle	15,000	3,660	56,901	139,340	114,356	− 24,984
Union	277,337	315,786	349,625	368,194	382,956	+ 14,762
Webster	122,116	278,042	371,560	298,715	347,817	+ 49,102
Whitley	591,068	687,831	710,747	788,836	793,902	+ 5,066
Other counties and small mines	150,000	59,153	167,371	170,031	300,912	+ 130,881
Total	5,469,986	6,766,984	7,538,032	7,576,482	8,432,523	+ 856,041
Total value	$5,213,076	$6,666,967	$7,979,342	$7,868,192	$8,385,232	+$517,040

[a] Includes Morgan County.

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 5 years, with the increases and decreases in 1905. It will be noted that nearly two-thirds of the increased production in 1905 was in the western district, which shows a gain of 560,862 short tons, compared with an increase of 295,179 short tons in the eastern district.

Coal production of the eastern district of Kentucky, 1901–1905.

[Short tons.]

County.	1901.	1902.	1903.	1904.	1905.	Increase or decrease in 1905.
Bell	333,235	461,768	392,016	521,662	757,413	+235,751
Boyd	173,930	242,021	245,491	69,095	48,304	− 20,791
Breathitt	18,540	23,873	32,730	42,355	32,340	− 10,015
Carter	245,526	281,401	265,226	245,030	145,169	− 99,861
Greenup	....	....	3,167	2,742	1,543	− 1,199
Johnson	[a] 37,692	126,473	77,100	41,120	57,310	+ 16,190
Knox	283,706	481,819	543,557	577,778	579,386	+ 1,608
Laurel	315,698	402,997	392,288	380,667	445,958	+ 65,291
Lawrence	46,924	57,387	66,826	69,036	37,481	− 31,555
Lee	18,786	36,651	47,571	67,948	94,597	+ 26,649
Pulaski	138,787	159,497	196,287	197,796	184,319	− 13,477
Rockcastle	15,000	3,660	56,901	139,340	114,356	− 24,984
Whitley	591,068	687,831	710,747	788,836	793,902	+ 5,066
Other counties and small mines	90,000	40,000	129,065	68,013	214,519	+146,506
Total	2,308,892	3,005,378	3,158,972	3,211,418	3,506,597	+295,179

[a] Includes Morgan County.

Coal production of the western district of Kentucky, 1901–1905.

[Short tons.]

County.	1901.	1902.	1903.	1904.	1905.	Increase or decrease in 1905.
Butler	18,802	12,868	3,600	1,647	18,199	+ 16,552
Christian	73,220	87,353	99,226	91,943	89,766	− 2,177
Daviess	16,205	20,518	44,286	44,125	61,780	+ 17,655
Hancock	8,220	17,837	37,032	49,854	47,817	− 2,037
Henderson	169,365	158,471	178,871	151,103	175,226	+ 24,123
Hopkins	1,362,299	1,555,084	1,743,721	1,691,675	2,013,715	+322,040
McLean	17,716	54,568	127,869	117,616	109,429	− 8,187
Muhlenberg	532,840	700,700	798,892	934,048	1,050,501	+116,453
Ohio	502,974	541,226	586,072	514,126	542,327	+ 28,201
Union	277,337	315,786	349,625	368,194	382,956	+ 14,762
Webster	122,116	278,042	371,560	298,715	347,817	+ 49,102
Other counties and small mines	60,000	19,153	38,306	102,018	86,393	− 15,625
Total	3,161,094	3,761,606	4,379,060	4,365,064	4,925,926	+560,862

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 1905 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. The Chesapeake and Ohio has 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 portion of the 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 Dekoven, in Union County.

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 5 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, 1829–1905.

[Short tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1829	2,000	1855	200,000	1881	1,232,000
1830	2,000	1856	215,000	1882	1,300,000
1831	2,100	1857	240,000	1883	1,650,000
1832	2,500	1858	250,000	1884	1,550,000
1833	2,750	1859	275,000	1885	1,600,000
1834	5,000	1860 [a]	285,760	1886	1,550,000
1835	6,000	1861	280,000	1887	1,933,185
1836	8,000	1862	275,000	1888	2,570,000
1837	10,000	1863	250,000	1889	2,399,755
1838	11,500	1864	250,000	1890	2,701,496
1839	16,000	1865	200,000	1891	2,916,069
1840 [a]	23,527	1866	180,000	1892	3,025,313
1841	35,000	1867	175,000	1893	3,007,179
1842	50,000	1868	160,000	1894	3,111,192
1843	60,000	1869	160,000	1895	3,357,770
1844	75,000	1870 [a]	150,582	1896	3,333,478
1845	100,000	1871	250,000	1897	3,602,097
1846	115,000	1872	380,800	1898	3,887,908
1847	120,000	1873	400,000	1899	4,607,255
1848	125,000	1874	360,000	1900	5,328,964
1849	140,000	1875	500,000	1901	5,469,986
1850	150,000	1876	650,000	1902	6,766,984
1851	160,000	1877	850,000	1903	7,538,032
1852	175,000	1878	900,000	1904	7,576,482
1853	180,000	1879	1,000,000	1905	8,432,523
1854	190,000	1880 [a]	946,288		

[a] United States census, fiscal year.

RESULTS OF TESTS OF KENTUCKY COALS.

The more important features of the results of tests made on Kentucky coals at the Geological Survey Coal-Testing Plant[a] at St. Louis, Mo., are briefly summarized below. For more detailed reports see Professional Paper No. 48, and Bulletin No. 290 of the United States Geological Survey.

[a] For brief description of the equipment used in these tests see page 6.

Kentucky, No. 1.—Operator, National Coal and Iron Company. Mine, Straight Creek No. 2, at Straight Creek, Bell County. Seam, Straight Creek. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	2.91	2.81	3.10
	Volatile matter	36.01	37.08	36.12
	Fixed carbon	57.55	57.31	56.39
	Ash	3.53	2.80	4.39
Ultimate.	Sulphur	.89	.84	1.22
	Hydrogen	....	....	5.43
	Carbon	....	....	77.37
	Nitrogen	....	....	1.83
	Oxygen	....	....	9.76
Calorific value determined:				
	Calories	7,957	....	7,860
	British thermal units	14,322	....	14,148

Boiler test: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 9.06 pounds; dry coal consumed per electrical horsepower per hour, 3.86 pounds.

Coking test: Unwashed coal yielded hard, brittle, fine-fingered coke.

Briquetting test: This coal can be briquetted very readily. Good results were had with 6 per cent of a soft pitch.

Kentucky, No. 1 B.—Operator, Straight Creek Coal and Coke Company. Mine, No. 2, at Straight Creek, Bell County. Kind of coal, bituminous, 3 inch, 1 inch, ¾ inch, and slack.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	3.42	3.25	5.21
	Volatile matter	35.90	36.08	33.47
	Fixed carbon	57.50	57.74	53.10
	Ash	3.18	2.93	8.22
Ultimate.	Sulphur	1.53	.91	1.12
	Hydrogen	....	....	5.28
	Carbon	....	....	73.08
	Nitrogen	....	....	1.67
	Oxygen	....	....	10.63
Calorific value determined:				
	Calories	7,986	....	7,341
	British thermal units	14,375	....	13,214

Boiler tests: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 9.34 and 9.57 pounds; dry coal consumed per electrical horsepower per hour, 3.74 and 3.65 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.37 pounds.

Coking test: Crushed ¾ to 3 inch coal, raw, burned 51 hours, gave 66.88 per cent gray silvery, fine-fingered and somewhat brittle coke; raw slack burned 64 hours, gave 60.99 per cent good light-gray coke, containing 12.47 per cent ash and 0.96 per cent sulphur. Better coke can probably be had by washing coal.

Kentucky, No. 2.—Operator, St. Bernard Mining Company. Mine, No. 11, at Earlington, Hopkins County. Seam, No. 11. Kind of coal, bituminous, over ⅞-inch screen.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	8.49	7.80	7.91
	Volatile matter	38.05	37.60	37.94
	Fixed carbon	46.36	44.38	45.02
	Ash	7.10	10.22	9.13
Ultimate.	Sulphur	3.53	4.20	3.62
	Hydrogen			5.48
	Carbon			65.81
	Nitrogen			1.22
	Oxygen			14.74
Calorific value determined:				
	Calories	6,858		6,778
	British thermal units	12,344		12,200

Boiler test: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 8.16 pounds; dry coal consumed per electrical horsepower per hour, 4.28 pounds.

Briquetting test: Good briquets can be made with 5 to 6 per cent of suitable soft pitch. Those made with 8 per cent pitch were excellent in every way, with a crushing strength of 11,300 pounds to the square inch.

Kentucky, No. 3.—Operator, St. Bernard Mining Company. Mine, Barnsley, at Barnsley, Hopkins County. Seam, No. 9. Kind of coal, bituminous. Run of mine and coal over ⅞-inch screen.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	9.10	7.98	7.92
	Volatile matter	36.21	37.55	36.09
	Fixed carbon	46.64	45.17	45.93
	Ash	8.05	9.30	10.06
Ultimate.	Sulphur	2.97	4.03	3.52
	Hydrogen			5.39
	Carbon			65.29
	Nitrogen			1.40
	Oxygen			14.34
Calorific value determined:				
	Calories		6,647	6,679
	British thermal units		11,965	12,022

Boiler test: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 8.27 pounds; dry coal consumed per electrical horsepower per hour, 4.22 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.91 pounds.

Coking test: Yielded coke of fair quality.

Washing test: Impurities in coke reduced but little by washing coal. Coal before washing contained 10.06 per cent ash and 3.52 per cent sulphur, and after washing 7.40 per cent and 2.51 per cent, respectively.

Kentucky, No. 4.—Operator, Wheatcroft Coal and Mining Company. Mine, Wheatcroft, at Wheatcroft, Webster County. Seam, No. 11. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	4.61	4.76	5.27
	Volatile matter	38.17	39.72	35.07
	Fixed carbon	49.82	48.51	45.48
	Ash	7.40	7.01	14.18
Ultimate.	Sulphur	3.33	3.21	4.54
	Hydrogen	....	....	4.71
	Carbon	....	....	64.65
	Nitrogen	....	....	1.24
	Oxygen	....	....	10.68
Calorific value determined:				
	Calories	7,145	....	6,639
	British thermal units	12,861	....	11,950

Boiler test: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 8.21 pounds; dry coal consumed, per electrical horsepower per hour, 4.25 pounds.

Coking test: By burning 10,000 pounds of washed coal 66 hours 5,558 pounds of coke of good color and ring were obtained; coke too high in sulphur for blast furnace use.

Washing test: Washing more successful than in case of any other Kentucky coal tested in 1904. Contents of 14.18 per cent ash and 4.54 per cent sulphur were reduced to 6.05 and 2.74, respectively.

Kentucky, No. 5.—Operator, Interstate Investment Company. Mine, Gilliam's Rockhouse Prospect, on Big Black Mountain, Harlan County. Seam, High Splint. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.			Car sample.
Proximate.	Moisture	4.45	4.72	4.32	4.36
	Volatile matter	36.27	35.74	36.04	35.02
	Fixed carbon	56.05	57.06	57.36	56.92
	Ash	3.23	2.48	2.28	3.70
Ultimate.	Sulphur	.54	.54	.48	.67
	Hydrogen	....	....	....	5.16
	Carbon	....	....	....	77.44
	Nitrogen	....	....	....	1.57
	Oxygen	....	....	....	11.46
Calorific value determined:					
	Calories	....	....	7,845	7,735
	British thermal units	....	....	14,121	13,923

Boiler test: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 10.42 pounds; dry coal consumed per electrical horsepower per hour, 3.35 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.33 pounds.

Coking test: Crushed raw coal burned 49 hours gave 66.61 per cent fine, heavy, silvery coke, containing 5.23 per cent ash and 0.41 per cent sulphur.

Kentucky, No. 6.—Mine, Miller Creek country bank, 5 miles southeast of Paintsville, Johnson County. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	6.95	6.52	5.12
	Volatile matter	35.03	34.42	36.49
	Fixed carbon	55.99	56.80	55.63
	Ash	2.03	2.26	2.76
Ultimate.	Sulphur	.48	.45	.57
	Hydrogen			5.47
	Carbon			77.20
	Nitrogen			1.45
	Oxygen			12.55
Calorific value determined:				
	Calories	7,604		7,635
	British thermal units	13,687		13,743

Boiler tests: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 9.96 and 9.86 pounds; dry coal consumed per electrical horsepower per hour, 3.51 and 3.54 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.27 pounds.

Coking test: Crushed raw coal, two charges, burned 56 and 55 hours, yielded 56.50 and 55.49 per cent, respectively, of fine-fingered, silvery coke, with ½-inch black butts.

Kentucky, No. 7.—Operator, Central Coal and Iron Company. Mine, Central, at Central City, Muhlenberg County. Kind of coal, bituminous, over 1½-inch bar screen ("standard lump").

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	8.76	8.75	8.47
	Volatile matter	35.02	34.00	35.24
	Fixed carbon	48.80	46.48	46.81
	Ash	9.42	10.77	9.48
Ultimate.	Sulphur	4.07	3.69	3.60
	Hydrogen			5.24
	Carbon			65.77
	Nitrogen			1.28
	Oxygen			14.63
Calorific value determined:				
	Calories	6,647		6,659
	British thermal units	11,965		11,986

Boiler test: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 8.38 pounds; dry coal consumed per electrical horsepower per hour, 4.17 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.51 pounds.

Coking test: Crushed raw coal, burned 40 hours, yielded 57.21 per cent silvery, good-weight coke, high in sulphur, and ash quality might be improved by washing coal.

MARYLAND.

Total production in 1905, 5,108,539 short tons; spot value, $5,831,760.

The coal production of Maryland in 1905 exceeded that of 1904 by 294,917 short tons and that of 1903 by 262,374 tons, but did not attain the high point reached in 1902, when, because of the strike in the anthracite region of Pennsylvania, Maryland's production reached the maximum output of any year in the history of the State—5,271,609 short tons. The coal-producing region in Maryland is confined to a comparatively small area in the western part of the State, from which to the close of 1905 over 136,000,000 tons have been mined. The output has not varied materially during the last ten years, and on account of the restricted area and the fact that the field is fairly well developed it is not probable that any marked increase in production will be obtained.

The maximum of value was attained in 1903, when the highest average price in recent years was recorded. In that year, with a product of 4,846,165 tons, the total value amounted to $7,189,784, an average of $1.48 per ton. In the preceding year the average price was $1.06 per ton. Prior to that it had not been as high as $1 per ton in recent years. The average price in 1905 was $1.14, against $1.19 in 1904. Notwithstanding this decline in price, the total value increased from $5,729,085 to $5,831,760, a gain of $102,675.

The total number of men employed in the coal mines of Maryland in 1905 was 5,948, who made an average of 252 days, against 5,671 men for 226 days in 1904. The average production per man for the year was 858.9 short tons and for each working day per man, 3.41 tons, against 848.8 tons for the year and 3.76 tons per day in 1904, and 827.1 tons for the year and 3.78 tons per day in 1903. The average daily tonnage per man in 1905 was the lowest in several years.

Out of a total of 54 mines which reported to the Geological Survey in 1905, 39, employing an aggregate of 5,385 men, worked 10 hours a day; 2 mines with 60 men worked 9 hours, and 2 with 70 men worked 8 hours. Eleven mines, which employed 433 men, did not report the number of hours to the day. In 1904 4,531 men out of a total of 5,671 worked 10 hours, and in 1903 3,808 out of a total of 5,859 were reported as working 10 hours per day.

The statistics relating to the undercutting of coal by machines show that while the number of machines in use increased from 38 in 1904 to 42 in 1905, the amount of machine-mined coal decreased from 484,373 tons to 468,822 tons.

There were no strikes reported at any of the mines in Maryland either in 1904 or 1905.

Mr. Thomas Murphy, State mine inspector, reports that in the fiscal year ended May 1, 1906, there were 72 casualties among the miners. Of these, 13 were fatal and 59 nonfatal. Ten wives were made widows and 26 children fatherless. Taking the statistics of production as reported for the calendar year, it is found that there were 2.19 fatalities for each thousand employed, and 392,964 tons mined to each life lost.

The statistics of production during the last five years, with the distribution of the product for consumption, are shown in the following table:

Distribution of the coal product of Maryland, 1901–1905.

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.*				
1901	5,043,991	41,282	27,854	5,113,127	$5,046,491	$0.99	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
1905	5,010,997	49,779	47,763	5,108,539	5,831,760	1.14	252	5,948

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 100 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.

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 shipments have been carefully preserved and are published annually in the reports of the Cumberland Coal Trade, and the table following, which shows the shipments from this entire region, has been obtained from these reports.

The annual production from the mines of Maryland alone, from 1842 to the close of 1905, will be found in the table giving the history of coal production in the United States from the earliest times on page 18.

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 1905, inclusive.

[Long tons.]

Frostburg region.				Piedmont region.		Total.			Aggregate.
Georges Creek and Cumberland R. R.				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.	
By Chesapeake and Ohio Canal.	By Pennsylvania R. R.	Local and Baltimore and Ohio R. R.	Total.						
....	....	....	....	....	....	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.				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.
					Eckhart Branch R. R.		
1870	909,511	520,196	....	1,429,707	114,404	83,941	198,345
1871	1,247,279	656,085	....	1,903,364	69,864	194,254	264,118
1872	1,283,956	612,537	22,021	1,918,514	26,586	203,666	230,252
1873	1,509,570	641,220	114,589	2,265,379	89,765	137,582	227,347
1874	1,295,804	631,882	67,671	1,995,357	113,670	135,182	248,852
1875	1,095,880	715,673	160,213	1,971,766	52,505	164,165	216,670
1876	939,262	443,435	131,866	1,514,563	15,285	189,005	204,290
1877	755,278	473,946	170,884	1,400,108	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)
1905	3,139,334	175,947	305,863	3,621,144	(a)	(a)	(a)
Total	59,431,701	12,789,392	6,603,484	78,824,577	8,609,691	4,219,351	12,829,042

[a] Merged in Cumberland and Pennsylvania figures.

Maryland and West Virginia from 1842 to 1905, inclusive—Continued.

[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.
				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	....	4,672,341	222,571	1,137,264	6,032,176
....	552,993	122,180	675,173	1,997,287	....	4,690,490	205,964	1,008,934	5,905,388
....	426,451	129,798	556,249	2,049,291	....	[b]5,111,968	175,947	938,769	6,226,684
585,001	13,973,844	4,490,614	19,049,459	27,159,580	1,475,969	99,229,767	18,889,194	27,371,058	145,490,019

[b] Includes 203,946 tons used on line of Cumberland and Pennsylvania Railroad and its branches, and at Cumberland and Piedmont; also 348,862 tons used by the Baltimore and Ohio Railroad Company in locomotives, rolling mills, etc.

RESULTS OF TESTS OF MARYLAND COALS.

The more important features of the results of the only test made on Maryland coal at the Geological Survey coal-testing plant[a] at St. Louis, Mo., are briefly summarized below. For more detailed reports see Professional Paper No. 48 and Bulletin No. 290 of the United States Geological Survey:

Maryland, No. 1.—Operator, Piedmont and Georges Creek Coal Company. Mine, No. 3, 2 miles north of Westernport, Garrett County. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	2.47	3.45	2.33
	Volatile matter	14.03	13.73	16.11
	Fixed carbon	73.95	71.97	68.43
	Ash	9.55	10.85	13.13
Ultimate.	Sulphur	1.23	1.60	1.49
	Hydrogen			3.99
	Carbon			75.21
	Nitrogen			1.29
	Oxygen			4.89
Calorific value determined:				
	Calories	7,696		7,364
	British thermal units	13,853		13,255

Boiler test: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 9.06 pounds; dry coal consumed per electrical horsepower per hour, 3.85 pounds.

Coking test: Crushed raw coal burned 36 hours made no coke, nor did crushed washed coal burned 48 hours. Crushed washed coal with 10 per cent pitch yielded 58.13 per cent of very poor coke, dull-gray, soft, and dense.

Washing test: Coal crushed to 2 inches, modified Stewart jig used, slight decrease in ash, from 13.13 to 10.61 per cent.

MICHIGAN.

Total production in 1905, 1,473,211 short tons; spot value, $2,512,697.

Compared with 1904, when the production of coal in Michigan amounted to 1,342,840 short tons, valued at $2,424,935, the output in 1905 shows an increase of 130,371 short tons, or 9.7 per cent, in quantity, and of $87,762, or 4 per cent, in value. The average price per ton declined from $1.81 in 1904 to $1.71 in 1905.

There were employed in the coal mines of the State in 1905 3,696 men who worked an average of 186 days, against 3,549 men, for an average of 183 days in 1904, and 2,768 men for 222 days in 1903. The average production for each man employed in 1905 was 398.6, compared with 378.4 in 1904, and 494.1 short tons in 1903. The average daily tonnage per man was 2.14 in 1905, 2.07 in 1904, and 2.23 in 1903. The coal mines of Michigan were entirely free from strikes in 1905, no labor troubles of any kind having been reported.

The use of mining machines in the production of coal in Michigan has shown a decided advance in the last two years, the number of machines in use having increased from 46 in 1903 to 85 in 1904, and to 106 in 1905. The machine-mined product in 1905 was 432,266 short tons, as compared with 310,007 short tons in 1904, and 180,943 short tons in 1903. Notwithstanding this increase in machine-mined coal there has, as previously shown, been a marked decrease in the individual efficiency of the mine workers, for which no explanation is given. The majority of the mines in the State are operated on the basis of an 8-hour day.

[a] For brief description of the equipment used in these tests see page 6.

According to the report of Mr. Malcolm J. McLeod, Commissioner of Labor, acci-ents occurred in 25 mines in the State of Michigan during 1905. The total number f accidents amounted to 43, of which 8 were fatal, 12 were reported as serious, 18 as evere, and 5 slight.

No statement was made as to the number of men killed who were married or who eft any children.

The death rate per thousand employees was 2.16. The number of tons mined for ach life lost was 184,151.

The statistics of production during the last 2 years, by counties, with the distribu-ion of the product for consumption, are shown in the following tables.

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

Coal production of Michigan in 1905, 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 ton.	*Short tons.*	*Short tons.*	*Short tons.*				
Bay	494,693	28,699	20,762	544,154	$949,972	$1.75	173	1,224
Eaton and Jackson[a]		13,000	254	13,254	30,876	2.33	180	50
Saginaw	855,891	25,029	34,883	915,803	1,531,849	1.67	193	2,422
Total	1,350,584	66,728	55,899	1,473,211	2,512,697	1.71	186	3,696

[a] Including the output of small mines.

In the following table is shown the total production, by counties, during the last 5 years, with the increases and decreases in 1905 as compared with the preceding year:

Coal production of Michigan, 1901–1905, by counties.

[Short tons.]

County.	1901.	1902.	1903.	1904.	1905.	Increase or decrease, 1905.
Bay	253,821	248,645	325,021	410,634	544,154	+133,520
Eaton	4,803	8,080	7,393	9,057	4,058	− 4,999
Huron	7,850	5,400				
Jackson	20,288	23,889	23,307	16,860	9,196	− 7,664
Saginaw	938,042	670,304	1,011,898	906,289	915,803	+ 9,514
Shiawassee	16,437	8,400				
Total	1,241,241	964,718	1,367,619	1,342,840	1,473,211	+130,371
Total value	$1,753,064	$1,653,192	$2,707,527	$2,424,935	$2,512,697	+$87,762

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.

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 Prof. Alfred C. Lane, there 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.

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.

Although coal mining in Michigan began about 70 years ago it was not until within the last ten years that it assumed any importance as an industry. Prior to 1896 there were only four years in which the production amounted to as much as 100,000 tons. During the last decade the rapid growth of the population and manufacturing industries of the cities along the shores of Lake Huron has created a market for Michigan coals and the production has increased rapidly except for a setback in 1902 due to strikes among the mine workers. The record of production since 1860 is shown in the following table:

Coal production of Michigan, 1860–1905.

[Short tons.]

Year	Quantity.	Year.	Quantity.	Year.	Quantity.
1860 [a]	2,320	1876	66,000	1891	80,307
1861	3,000	1877	69,197	1892	77,990
1862	5,000	1878	85,322	1893	45,979
1863	8,000	1879	82,015	1894	70,022
1864	12,000	1880 [a]	100,800	1895	112,322
1865	15,000	1881	112,000	1896	92,882
1866	20,000	1882	135,339	1897	223,592
1867	25,000	1883	71,296	1898	315,722
1868	28,000	1884	36,712	1899	624,708
1869	29,980	1885	45,178	1900	849,475
1870 [a]	28,150	1886	60,434	1901	1,241,241
1871	32,000	1887	71,461	1902	964,718
1872	33,600	1888	81,407	1903	1,367,619
1873	56,000	1889	67,431	1904	1,342,840
1874	58,000	1890	74,977	1905	1,473,211
1875	62,500				

[a] United States census, fiscal year.

MISSOURI.

Total production in 1905, 3,983,378 short tons; spot value, $6,291,661.

The unsatisfactory conditions which prevailed among the coal-producing States of the Mississippi Valley during 1905 were particularly emphasized in Missouri, where not only were prices depressed below those obtained in the two preceding years but production also fell off. Compared with 1904, when the output amounted to 4,168,308 short tons, valued at $6,801,751, the production in 1905 exhibits a decrease of 184,930 short tons, or 4.4 per cent, and a loss in value of $510,090, or 7.5 per cent. The average price per ton declined from $1.63 in 1904 to $1.58 in 1905. There was, however, in Missouri, as in the adjoining States of Iowa and Kansas, an increased efficiency in the producing capacity of the men, as shown by the decrease in the number of men employed and the fewer average days worked. In 1904, 10,137 men worked an average of 206 days and produced 4,168,308 tons, an average per man for the year of 411.2 tons and per day of 2 tons. Last year 8,962 men were engaged for an average of 194 days in the production of 3,983,378 short tons, making an average for each man of 444.5 tons for the year and of 2.3 tons per day.

The production by the use of machines was about the same in both years. Thirty-one machines were reported in operation in 1904, and the machine-mined product amounted to 376,505; in 1905, 30 machines were used in the production of 375,194 short tons of coal. The coal seams of Missouri, where machines are used, are generally thin and adapted to the long-wall method of mining. Twenty-eight of the 30 machines in use in 1905 were long-wall machines.

Strikes among the miners in 1905 were few and of unimportance. One, affecting 50 men, lasted 30 days, and one, which affected 255 men at the four mines of the Great Northern Fuel Company, in Adair County, lasted 16 days. In all, there were 435 men idle for an average of 16 days during the year.

Practically all of the coal-mining business in Missouri is conducted on the basis of an 8-hour day; in 1905, out of a total of 231 mines, 194 reported 8 hours as the length of the working day. These mines employed 8,096 out of the 8,962 men reported for the State. Six mines, employing a total of 70 men, worked 9 hours, and 4 small properties, having a total of 25 men, worked 10 hours. Four mines in which a total of 41 men were employed reported 7 hours. There were 23 mines that did not report the number of hours worked. These employed 730 men.

The statistics of production in 1904 and 1905, by counties, with the distribution of the product for consumption, are shown in the following tables:

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	1,183,333	1.73	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
Other counties[a]	244,442	33,727	14,085	292,254	487,721	1.67	189	694
Small mines	....	36,241	....	36,241	69,759	......	....	....
Total	3,803,400	274,089	90,819	4,168,308	6,801,751	1.63	206	10,137

[a] Caldwell, Chariton, Clay, Dade, Grundy, Howard, Jackson, Johnson, Livingston, Moniteau, Monroe, Montgomery, Morgan, Pettis, St. Clair, Schuyler, and Vernon.

Coal production of Missouri in 1905, 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	581,939	9,948	11,812	603,699	$847,945	$1.40	181	1,328
Audrain	34,688	17,142	1,293	53,123	94,675	1.78	186	184
Barton	228,123	7,300	5,690	241,113	319,609	1.33	186	509
Bates	152,297	11,420	4,155	167,872	231,754	1.38	195	419
Boone	16,097	24,481	208	40,786	70,042	1.72	190	146
Callaway	5,000	11,894	412	17,306	32,702	1.89	222	62
Henry	108,573	16,044	1,371	125,988	209,998	1.67	205	297
Lafayette	621,476	36,661	8,886	667,023	1,150,278	1.72	223	1,559
Linn	74,306	20,161	708	95,175	207,379	2.18	221	327
Livingston	....	2,825	....	2,825	6,130	2.17	171	14
Macon	777,456	6,631	15,426	799,513	1,172,804	1.47	196	1,634
Putnam	71,490	5,812	1,860	79,162	143,899	1.82	140	363
Ralls	14,324	233	....	14,557	24,902	1.71	204	42
Randolph	451,652	28,974	10,778	491,404	761,564	1.55	196	715
Ray	190,691	33,985	11,922	236,598	442,456	1.87	157	869
Schuyler	17,786	2,745	526	21,057	32,594	1.55	186	79
Other counties[a]	213,916	46,837	10,850	271,603	438,497	1.61	223	415
Small mines	....	54,574	....	54,574	104,433	1.91	....	....
Total	3,559,814	337,667	85,897	3,983,378	6,291,661	1.58	194	8,629

[a] Benton, Caldwell, Cass, Clay, Dade, Howard Johnson, Monroe, Montgomery, Pettis, St. Clair, and Vernon.

The production by counties during the last 5 years, with the increases and decreases in 1905 as compared with 1904, is shown in the following table:

Coal production in Missouri, 1901–1905, by counties.

[Short tons.]

County.	1901.	1902.	1903.	1904.	1905.	Increase or decrease in 1905.
Adair	358,011	331,159	526,975	615,607	603,699	− 11,908
Audrian	35,916	26,208	26,835	44,179	53,123	+ 8,944
Barton	144,354	200,346	193,816	230,875	241,113	+ 10,238
Bates	281,020	354,707	149,963	139,026	167,872	+ 28,846
Boone	22,629	27,006	19,752	37,920	40,786	+ 2,866
Caldwell	20,430	16,000	11,485	15,366	15,000	− 366
Callaway	28,008	26,422	25,837	12,058	17,306	+ 5,248
Grundy	42,361	34,936	25,565	15,597	....	− 15,597
Henry	82,586	98,831	59,710	134,651	125,988	− 8,663
Jackson	20,000	21,000	8,500	4,050	....	− 4,050
Johnson	11,255	5,540	1,458	1,572	1,712	+ 140
Lafayette	438,922	543,801	639,480	682,419	667,023	− 15,396
Linn	85,256	81,108	66,319	111,095	95,175	− 15,920
Livingston	900	2,138	4,095	2,959	2,825	− 134
Macon	1,040,976	1,064,726	1,180,653	914,303	799,513	− 114,790
Montgomery and Morgan	3,474	[a] 4,101	7,583	8,146	[a] 3,200	− 4,946
Putnam	133,397	127,983	112,740	71,266	79,162	+ 7,896
Ralls	23,688	19,372	17,185	16,572	14,557	− 2,015
Randolph	403,403	424,167	604,240	585,135	491,404	− 93,731
Ray	267,432	235,066	296,922	244,707	236,598	− 8,109
Vernon	238,070	218,339	181,358	178,006	195,201	+ 17,195
Other counties and small mines	120,000	27,198	78,115	102,799	132,121	+ 29,322
Total	3,802,088	3,890,154	4,238,586	4,168,308	3,983,378	− 184,930
Total value	$4,707,164	$5,374,642	$6,834,297	$6,801,751	$6,291,661	−$510,090

[a] Montgomery County only.

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 Pennsylvania 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, noncoking 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.

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, 1840–1905.

[Short tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1840 [a]	9,972	1862	320,000	1884	2,800,000
1841	12,000	1863	360,000	1885	3,080,000
1842	15,000	1864	375,000	1886	1,800,000
1843	25,000	1865	420,000	1887	3,209,916
1844	35,000	1866	450,000	1888	3,909,967
1845	50,000	1867	500,000	1889	2,557,823
1846	68,000	1868	541,000	1890	2,735,221
1847	80,000	1869	550,000	1891	2,674,606
1848	85,000	1870 [a]	621,930	1892	2,773,949
1849	90,000	1871	725,000	1893	2,897,442
1850	100,000	1872	784,000	1894	2,245,039
1851	125,000	1873	784,000	1895	2,372,393
1852	140,000	1874	789,680	1896	2,331,542
1853	160,000	1875	840,000	1897	2,665,626
1854	175,000	1876	1,008,000	1898	2,688,321
1855	185,000	1877	1,008,000	1899	3,025,814
1856	200,000	1878	1,008,000	1900	3,540,103
1857	220,000	1879	1,008,000	1901	3,802,088
1858	240,000	1880 [a]	844,304	1902	3,890,154
1859	260,000	1881	1,960,000	1903	4,238,586
1860 [b]	280,000	1882	2,240,000	1904	4,168,308
1861	300,000	1883	2,520,000	1905	3,983,378

[a] United States census, fiscal year.
[b] Census figures for 1860 are 3,880 short tons, but this is evidently an error.

RESULTS OF TESTS OF MISSOURI COALS.

The more important features of the results of tests made on Missouri coals at the Geological Survey coal-testing plant[a] at St. Louis, Mo., are briefly summarized below. For more detailed reports, see Professional Paper No. 48 and Bulletin No. 290 of the United States Geological Survey.

[a] For brief description of the equipment used in these tests, see p. 6.

Missouri, No. 1.—Operator, New Home Coal Company. Mine, No. 1, at New Home, Bates County. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	4.80	4.92	8.33
	Volatile matter	38.10	38.28	33.58
	Fixed carbon	42.93	42.28	38.73
	Ash	14.17	14.52	19.36
Ultimate.	Sulphur	5.35	5.34	5.25
	Hydrogen			4.97
	Carbon			57.00
	Nitrogen			0.94
	Oxygen			12.48
Calorific value determined:				
	Calories		6,662	5,881
	British thermal units		11,992	10,586

Boiler test: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 7.92 pounds; dry coal consumed per electrical horsepower per hour, 4.41 pounds.

Briquetting test: Will briquet readily and make good briquets with 6 to 7 per cent of soft pitch.

Missouri, No. 2.—Operator, Northwestern Coal and Mining Company. Mine, No. 8, 1 mile south of Bevier, Macon County. Seam, Bevier. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	14.74	12.90	11.50
	Volatile matter	38.53	36.54	33.63
	Fixed carbon	38.95	39.90	38.01
	Ash	7.78	10.66	16.86
Ultimate.	Sulphur	3.79	3.83	5.16
	Hydrogen			5.12
	Carbon			54.79
	Nitrogen			0.96
	Oxygen			17.11
Calorific value determined:				
	Calories	6,214		5,655
	British thermal units	11,185		10,179

Boiler test (better of two trials): Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 7.26 pounds; dry coal consumed per electrical horsepower per hour, 4.81 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.71 pounds.

Washing test: In a charge for coking, the ash content was reduced from 16.86 to 7.76 per cent and the sulphur from 5.16 to 3.24.

Coking test: The washed coal yielded long-fingered brittle coke, high in ash and sulphur.

Missouri, No. 3.—Operator, Mendota Coal and Mining Company. Mine, at Mendota, Putnam County. Seam, Mendota. Kind of coal, bituminous, slack.

Chemical analysis.

			Car sample.
Proximate.	Moisture		15.71
	Volatile matter		28.62
	Fixed carbon		34.89
	Ash		20.78
Ultimate.	Sulphur		3.69
	Hydrogen		5.23
	Carbon		48.87
	Nitrogen		0.82
	Oxygen		20.61
Calorific value determined:			
	Calories		4,911
	British thermal units		8,840

Boiler test: Water evaporated by 1 pound of dry raw coal, at and from a temperature of 212° F., 5.82 pounds; dry coal consumed per electrical horsepower per hour, 6 pounds. With washed coal the figures are 7.43 and 4.70 pounds.

Coking test: Though washed, showed no tendency to coke.

Washing test: By a modified Stewart jig the ash in the very dirty coal was reduced from 28.39 per cent to 7.59 per cent, and the sulphur from 4.30 to 2.89 per cent, but the amount of coal lost was too great for economical work.

Missouri, No. 4.—Operator, Morgan County Coal Company. Mine, near Barnett, Morgan County. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	13.34	10.57	12.67
	Volatile matter	37.72	41.11	41.45
	Fixed carbon	42.03	42.17	41.05
	Ash	6.91	6.15	4.83
Ultimate.	Sulphur	5.06	5.00	5.12
	Hydrogen			6.18
	Carbon			66.87
	Nitrogen			0.69
	Oxygen			16.31
Calorific value determined:				
	Calories	6,447		6,937
	British thermal units	11,605		12,487

Boiler test: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 8.83 pounds, dry coal consumed per electrical horsepower per hour, 3.96 pounds.

Coking test: Unwashed coal gave fair coke, of gray color and good metallic ring, but too high in sulphur for the blast furnace. Better coke can probably be had by washing the coal.

MONTANA.

Total production in 1905, 1,643,832 short tons; spot value, $2,823,350.

The coal-mining industry of Montana has shown comparatively little change during the last 11 years, and although the production in 1905 exhibited an increase of 284,913 short tons, or 21 per cent, over that of 1904, it exceeded by only 130,000 tons the average production during the preceding 10 years, and was a little less than the output reported in 1897 and in 1900. The returns for 1905 do, however, indicate an unusual demand upon the coal mines of the State in that year, for, in addition to the increased production over the preceding year, prices showed a decided improvement and the total value an increase of $628,802, or 28.7 per cent, from $2,194,548 in 1904 to $2,823,350 in 1905. The average price advanced from $1.61 to $1.72 per short ton. The larger part of the coal produced in Montana is sold for locomotive use, and the improved conditions last year were doubtless due to increased business with the transportation companies.

Notwithstanding the increased production in 1905, the number of men employed shows a decided decrease, while the average number of working days was the same as in 1904. The total number of men employed in 1905 was 2,181, as compared with 2,505 men in 1904. The average number of days worked was 243 in both years, while in 1903 there were 2,155 men employed for an average of 254 days. The average production per man in 1905 was 753.7 tons, against 542.5 in 1904 and 691 in 1903. The average daily production per man was 3.1 in 1905, 2.23 in 1904, and 2.72 in 1903.

One mine in Montana was closed from January 1 to August 19 by a strike which had been inaugurated in August, 1904. This mine employed a total of 200 men, and it is the only instance of labor trouble reported in Montana during the year.

The statistics relating to the use of mining machines show that in 1905 there were 58 machines in use, against 57 in 1904 and 63 in 1903. The machine-mined production in 1905 amounted to 752,665 short tons, or 46 per cent of the total output, as compared with 482,924 short tons, or 35.5 per cent of the total output in 1904.

The statistics of production in Montana in 1904 and 1905, with the distribution of the product for consumption, are shown in the following tables:

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.

Coal production of Montana in 1905, 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	549,252	13,172	25,990	....	588,414	$925,036	$1.57	286	708
Cascade	793,165	11,746	21,115	....	826,026	1,383,750	1.68	239	972
Chouteau	1,500	5,000	....	....	6,500	13,340	2.05	217	12
Fergus	4,075	11,128	25	....	15,228	50,994	3.35	189	55
Park	2,514	512	10,004	68,777	81,807	241,463	2.95	148	312
Other counties[a]	115,300	962	6,994	....	123,256	201,050	1.63	297	122
Small mines	....	2,601	....	....	2,601	7,717	2.97	....	....
Total	1,465,806	45,121	64,128	68,777	1,643,832	2,823,350	1.72	243	2,181

[a] Deerlodge, Gallatin, and Meagher.

In the following table is presented a statement of the coal production of Montana, by counties, during the last 5 years, with the increases and decreases in 1905 as compared with 1904:

Production of coal in Montana, 1901–1905, by counties.

[Short tons.]

County.	1901.	1902.	1903.	1904.	1905.	Increase or decrease in 1905.
Carbon	498,560	604,954	589,997	544,976	588,414	+ 43,438
Cascade	789,407	761,572	733,064	599,158	826,026	+ 226,868
Chouteau	5,050	10,772	9,875	5,764	6,500	+ 736
Fergus	500	5,200	9,734	19,109	15,228	− 3,881
Gallatin	24,583	88,000	58,696	109,556	123,006	+ 13,450
Park	77,981	89,640	86,044	78,646	81,807	+ 3,161
Other counties and small mines	....	685	[a]1,400	1,710	2,851	+ 1,141
Total	1,396,081	1,560,823	1,488,810	1,358,919	1,643,832	+ 284,913
Total value	$2,009,316	$2,443,447	$2,440,846	$2,194,548	$2,823,350	+$628,802

[a] Includes production of small mines.

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 Clark Fork field, in the southwestern portion of Yellowstone and northeastern part of Sweet Grass 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, or 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, and, as shown in the foregoing table, 50 per cent of the total and 80 per cent of the increased production in 1905 were credited to this county. Carbon County, the second in importance in the State, produced a little less than one-third of the total output in 1905 and contributed about 15 per cent of the increase.

The coal-mining industry of Montana has, according to the records, just entered the second quarter century of its history. So far as known, the first coal produced in the State, or Territory, as it was then, was mined in 1880, in which year the production amounted to 224 tons. It was not until 1889, however, that the industry assumed any importance, the production increasing nearly 800 per cent, from 41,467 short tons in 1888 to 363,301 short tons the following year. During the next six years development rapidly advanced, until in 1895 it exceeded 1,500,000 tons. Since that date the annual production has remained comparatively steady, as shown in the following table:

Coal production of Montana, 1880–1905.

[Short tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1880	224	1889	363,301	1898	1,479,803
1881	5,000	1890	517,477	1899	1,496,451
1882	10,000	1891	541,861	1900	1,661,775
1883	19,795	1892	564,648	1901	1,396,081
1884	80,376	1893	892,309	1902	1,560,823
1885	86,440	1894	927,395	1903	1,488,810
1886	49,846	1895	1,504,193	1904	1,358,919
1887	10,202	1896	1,543,445	1905	1,643,832
1888	41,467	1897	1,647,882		

RESULTS OF TESTS OF MONTANA COALS.

The more important features of the results of tests made on Montana coal at the Geological Survey Coal Testing Plant[a] at St. Louis, Mo., are briefly summarized below. For more detailed reports see Professional Paper No. 48 and Bulletin No. 290 of the United States Geological Survey.

Montana No. 1.—. Mine, at Red Lodge, Carbon County. Kind of coal, black lignite, or subbituminous, No. 4 washed nut.

Chemical analysis.

		Car sample.
Proximate.	Moisture	11.05
	Volatile matter	35.90
	Fixed carbon	42.08
	Ash	10.97
Ultimate.	Sulphur	1.73
	Hydrogen	5.37
	Carbon	59.08
	Nitrogen	1.33
	Oxygen	21.52
Calorific value determined:		
	Calories	5,855
	British thermal units	10,539

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 2.25 pounds.
Briquetting test: Briquets were made with hard pitch and with soft pitch as binder.

[a] For brief description of the equipment used in these tests see page 6.

NEW MEXICO.

Total production in 1905, 1,649,933 short tons; spot value, $2,190,231.

Compared with 1904, when the coal production of New Mexico amounted to 1,452,325 short tons, valued at $1,904,499, the output in 1905 exhibits an increase of 197,608 short tons, or 13.6 per cent, and a gain in value of $285,732, or 15 per cent. The most notable increase was made in Colfax County, the principal producing county, and in which the only coke-making establishments in the Territory are located. In fact, the increase in Colfax County was larger by 45,000 tons than the total increase in the Territory, and small gains were made also in McKinley and Santa Fe counties, but these were partly offset by losses in Lincoln, Rio Arriba, and other producing counties. An augmented demand for coke was partially responsible for Colfax County's increase, the amount of coal made into coke showing a gain of nearly 60,000 tons.

The coal mines of New Mexico gave employment in 1905 to 2,108 men, who worked an average of 234 days, against 1,849 men for 228 days in 1904. Dividing the tonnage by the number of men employed it is seen that the average made for each employee was nearly the same in both years, 785.5 tons in 1904 and 782.7 tons in 1905. In 1903 the average production per man was 862. These figures, compared with those of other States and Territories, show that New Mexico stands near the top in the productive efficiency of the mine workers. There are only five States which show better records, and three of these are in the Rocky Mountain region—Colorado, Utah, and Wyoming. The others are Maryland and Pennsylvania (bituminous).

The average daily tonnage per man in New Mexico in 1905 was 3.34, against 3.45 in 1904 and 3.31 in 1903. The use of mining machines does not materially affect the production in the Territory nor the efficiency record of the miners. There are only two mines in New Mexico in which machines have been installed, and the machine-mined production is comparatively negligible. Most of the mines are operated on a 10-hour per day basis.

There were no strikes reported in New Mexico in 1905 and the number of accidents were few, five men, according to the report of Mr. Jo. Sheridan, Territorial mine inspector, being killed during the fiscal year ending June 30, 1905. The death rate per thousand employees was 2.35. The number of tons mined for each life lost was 306,860.

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 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
Other counties[a]	160,812	4,407	15,319	....	180,538	328,543	1.82	239	344
Small mines	....	142	....	....	142	172	1.21	....	....
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, Santa Fe, and Socorro.

Coal production of New Mexico in 1905, 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	838,518	14,449	17,151	161,711	1,031,829	$1,232,412	$1.19	256	1,087
McKinley	465,755	1,852	13,463	....	480,490	677,217	1.41	216	633
Other counties[a]	113,436	3,852	14,649	....	136,937	279,844	2.04	200	388
Small mines	....	677	....	....	677	758	1.12	....	....
Total	1,422,129	20,830	45,263	161,711	1,649,933	2,190,231	1.33	234	2,108

[a] Lincoln, Rio Arriba, Sandoval, San Juan, Santa Fe, and Socorro.

A statement of the production of coal in New Mexico, by counties, during the last five years, with the increases and decreases in 1905 as compared with 1904, is shown in the following table:

Coal production of New Mexico, 1901–1905, by counties.

[Short tons.]

County.	1901.	1902.	1903.	1904.	1905.	Increase or decrease in 1905.
McKinley	516,533	432,108	569,362	441,865	480,490	+ 38,625
Colfax	249,296	346,373	723,786	788,955	1,031,829	+ 242,874
Lincoln	156,621	99,000	97,229	70,964	19,143	− 51,821
Rio Arriba	38,942	47,600	35,500	40,825	31,700	− 9,125
Santa Fe	106,454	90,895	75,535	60,090	69,832	+ 9,742
Other counties	18,700	32,787	40,369	49,626	16,939	− 32,687
Total	1,086,546	1,048,763	1,541,781	1,452,325	1,649,933	+ 197,608
Total value	$1,546,652	$1,500,230	$2,105,785	$1,904,499	$2,190,231	+$285,732

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 Durango-Gallup field, which extends from Durango southward through Rio Arriba and McKinley counties to Gallup and Mount Taylor, and embraces a number of districts, of which the Gallup, Monero-Lumberton, and Fruitland are the principal producers in the Territory. 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 district, 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.

At the present time this field is attracting a great deal of attention, and it seems probable that extensive developments will be undertaken in the near future. Already the Denver and Rio Grande Railroad has built a standard-gage line southwest from Durango, Colo., to Farmington, N. Mex., and there are persistent rumors that the

Southern Pacific will build north through this field to Denver. If this is carried out, commercial development will doubtless follow on a considerable scale.

The quality of the coal in this field deteriorates southward, or away from the San Juan Mountains, and throughout most of New Mexico it is probably a high-grade black lignite.

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 less than one-tenth of what it is at the present time.

Coal production of New Mexico, 1882–1905.

[Short tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1882	157,092	1890	375,777	1898	992,288
1883	211,347	1891	462,328	1899	1,050,714
1884	220,557	1892	661,330	1900	1,299,299
1885	306,202	1893	665,094	1901	1,086,546
1886	271,285	1894	597,196	1902	1,048,763
1887	508,034	1895	720,654	1903	1,541,781
1888	626,665	1896	622,626	1904	1,452,325
1889	486,943	1897	716,981	1905	1,649,933

RESULTS OF TESTS OF NEW MEXICO COALS.

The more important features of the results of tests made on New Mexico coals at the Geological Survey coal-testing plant[a] at St. Louis, Mo., are briefly summarized below. For more detailed reports see Professional Paper No. 48 and Bulletin No. 290 of the United States Geological Survey.

New Mexico, No. 1.—Operator, American Fuel Company. Mine, Weaver, 3 miles north of Gallup, McKinley County. Seam, Nos. 3 and 3½. Kind of coal, black lignite, or subbituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
		Seam 3.	Seam 3½.	
Proximate.	Moisture	11.77	10.96	12.29
	Volatile matter	41.85	42.63	34.58
	Fixed carbon	43.11	42.39	46.14
	Ash	3.26	4.01	6.99
Ultimate.	Sulphur	0.54	0.52	0.63
	Hydrogen			5.82
	Carbon			63.31
	Nitrogen			1.03
	Oxygen			22.22
Calorific value determined:				
	Calories		6,603	6,251
	British thermal units		11,885	11,252

Boiler test: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 7.41 pounds; dry coal consumed per electrical horsepower per hour, 4.90 pounds.

Briquetting test: The most satisfactory test was with 8 per cent of a pitch obtained in manufacturing gas from heavy petroleum. The briquets were hard, strong, and clean, with a crushing strength of 13,050 pounds to the square inch.

[a] For brief description of the equipment used in these tests see page 6.

New Mexico, No. 2.—Operator, Caledonian Coal Company. Mine, Otero, 1½ miles east of Gallup, McKinley County. Seam, Otero, Thatcher, Crownpoint. Kind of coal, black lignite, slack.

Chemical analysis.

		Mine samples.				Car sample.
Proximate.	Moisture	9.13	9.68	9.40	10.80	10.79
	Volatile matter	40.77	41.42	40.05	40.35	33.82
	Fixed carbon	40.23	40.82	37.87	42.77	36.73
Proximate. / Ultimate.	Ash	9.87	8.08	12.68	6.08	18.66
	Sulphur	1.27	1.55	0.84	1.06	1.26
Ultimate.	Hydrogen	....	....	....	....	5.22
	Carbon	....	....	....	....	55.07
	Nitrogen	....	....	....	....	0.95
	Oxygen	....	....	....	....	18.84
Calorific value determined:						
	Calories	....	6,457	....	....	5,504
	British thermal units	....	11,623	....	....	9,907

Boiler test: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 6.41 pounds; dry coal consumed per electrical horsepower per hour, 5.45 pounds.

Briquetting test: Trials of hard and soft pitches in varying proportions definitely proved that similar dirty lignite can not be briquetted well with any commercial percentage of pitch as a binder, except, perhaps, a pitch made from petroleum.

NORTH CAROLINA.

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 output has been very irregular and during the last 3 years has notably declined. The largest production in recent years was in 1899, when 26,896 short tons were mined.

In the following table is shown the production during the last 5 years, with the distribution of the product for consumption:

Distribution of the coal product of North Carolina, 1901–1905.

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.*				
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
1905	461	1,096	....	1,557	2,336	1.50	60	15

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.

Coal production of North Carolina, 1840–1905.

[Short tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1840	3	1880	350	1893	17,000
1862	30,000	1881	300	1894	16,900
1863	30,000	1882	400	1895	24,900
1864	25,000	1883	400	1896	7,813
1865	20,000	1884	500	1897	21,280
1866	20,000	1885	500	1898	11,495
1867	20,000	1886	400	1899	26,896
1868	18,000	1887	300	1900	17,734
1869	16,000	1888	250	1901	12,000
1870	15,000	1889	222	1902	23,000
1871	15,000	1890	10,262	1903	17,309
1872	12,000	1891	20,355	1904	7,000
1873	10,000	1892	6,679	1905	1,557

NORTH DAKOTA.

Total production in 1905, 317,542 short tons; spot value, $424,778.

All of the coal produced in North Dakota is brown lignite, extensive beds of which underlie the western half of the State. It is not a high-grade fuel for heating purposes, and until 1896 the mining of it was carried on principally by ranchmen who had no other fuel. The production of lignite during the last ten years has, however, been considerably increased by the enactment of a law by the North Dakota legislature which compels the use of lignite in all State buildings and institutions. The production in 1905 was the largest in the history of the State, being 45,614 short tons, or 17 per cent in excess of that of 1904, and 38,897 short tons, or 14.0 per cent over that of 1903, when the largest previous output was obtained. The increased production was at a sacrifice in values, the average price having declined from $1.50 per ton in 1903 to $1.43 in 1904 and $1.34 in 1905. The total value in 1905 was only $6,773 more than that of 1903.

The coal mines of the State gave employment to 626 men in 1905, against 554 in 1904. They averaged 192 days in 1904 and 187 days in 1905. Most of the mines worked 10 hours. There were no strikes in 1905, while in the previous year there were 175 men idle for 36 days. The number of mining machines in use has been the same for the last 3 years—9 altogether. The machine-mined product in 1905 was 97,789 short tons, compared with 125,097 tons in 1904 and 115,222 tons in 1903.

The statistics of production in 1904 and 1905, by counties, with the distribution of the product for consumption, are shown in the following tables:

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	44,367	40,398	3,001	87,766	159,391	1.82	164	257
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	183,656	83,185	5,087	271,928	389,052	1.43	192	554

[a] Burleigh, Emmons, McLean, and Mercer.

Coal production of North Dakota in 1905, 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	19,100	6,950	50	26,100	$37,522	$1.44	152	67
Stark	35,917	12,750	750	49,417	56,761	1.15	211	72
Ward	81,684	49,248	6,610	137,542	190,292	1.38	215	258
Williams	6,282	2,864	122	9,268	17,710	1.91	104	65
Other counties[a]	64,531	26,517	2,824	93,872	121,000	1.29	177	173
Small mines	....	1,343	....	1,343	1,493	1.11	....	....
Total	207,514	99,672	10,356	317,542	424,778	1.34	187	626

[a] Burleigh, Emmons, McLean, and Mercer.

The production by counties during the last 5 years, with the increases and decreases in 1905 as compared with 1904, is shown in the following table:

Coal production of North Dakota, 1901–1905, by counties.

[Short tons.]

County.	1901.	1902.	1903.	1904.	1905.	Increase or decrease, 1905.
Burleigh	44,054	76,258	104,835	92,970	74,357	− 18,613
McLean	1,000	3,150	3,925	13,100	15,515	+ 2,415
Morton	52,850	18,317	13,500	10,663	26,100	+ 15,437
Stark	18,700	35,600	46,764	52,744	49,417	− 3,327
Ward	48,681	93,786	98,081	87,766	137,542	+ 49,776
Williams	....	....	8,935	9,185	9,268	+ 83
Emmons, Mercer	1,316	....	....	2,100	4,000	+ 1,900
Small mines	....	....	2,605	3,400	1,343	− 2,057
Total	166,601	226,511	278,645	271,928	317,542	+ 45,614
Total value	$214,151	$325,967	$418,005	$389,052	$424,778	+$35,726

Almost the entire western half of North Dakota is underlain by beds of lignite, which vary in thickness from a few inches to 33 feet. The lignite is local in its development, and cases are rare in which an individual bed can be traced or identified over more than 2 or 3 square miles of territory. For this reason careful prospecting with a pick along the river bluffs and with core drill on the upland is essential before development is undertaken.

According to the reports of the State geological survey, 97 townships contain in some part of their area at least one bed of lignite 7 feet or more thick, while at least 100 other townships contain beds, from 4 to 7 feet thick. The lignite is generally well exposed along such streams as Big and Little Missouri, Knife, Heart, and Mouse rivers. Mining is carried on to some extent at most of the towns along the Northern Pacific Railway west of Mandan, on the Minneapolis, St. Paul and Sault Ste. Marie Railway in the Mouse River Valley, and also north of Bismarck, and to a small extent along the Great Northern Railway near Minot and Williston. The total area underlain by lignite-bearing beds is estimated to be 35,000 square miles.

The lignite is brown and generally woody, and as it comes from the mine contains about 40 per cent of moisture. Upon exposure to the atmosphere the lignite loses some of this moisture, and as a result it "slacks" or crumbles to pieces. If exposed indefinitely it breaks down to a fine powder, with probably considerable oxidation and loss of volatile combustible matter.

On account of its heavy percentage of moisture and rapid disintegration on exposure it does not stand transportation well, and consequently its field of usefulness is limited. So far its principal use has been to supply fuel to the settlers on the treeless plains in the western part of the State, and for this purpose it has been mined in a crude way in almost every county in the lignite-bearing area. Commercial mines are situated on the lines of railway, and these supply the towns of the State with fuel for domestic purposes and for use under steam boilers. On account, however, of the large percentage of moisture contained in the lignite it has difficulty in meeting competition with Pennsylvania and West Virginia coals, which find their way into this country via the Great Lakes.

Lignite has doubtless been mined and used in North Dakota by ranchmen and others since the time when North Dakota was a Territory, but it was not until 1884 that any record of production was obtained. This was published in the volume Mineral Resources for that year. Since 1884 the production has been as follows:

Coal production of North Dakota, 1884–1905.

[Short tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1884	35,000	1892	40,725	1900	129,883
1885	25,000	1893	49,630	1901	166,601
1886	25,955	1894	42,015	1902	226,511
1887	21,470	1895	38,997	1903	278,645
1888	34,000	1896	78,050	1904	271,928
1889	28,907	1897	77,246	1905	317,542
1890	30,000	1898	83,895		
1891	30,000	1899	98,809		

RESULTS OF TESTS OF NORTH DAKOTA COALS.

The more important features of the results of tests made on North Dakota coals at the Geological Survey Coal Testing Plant[a] at St. Louis, Mo., are briefly summarized below. For more detailed reports see Professional Paper No. 48, and Bulletin No. 290 of the United States Geological Survey.

North Dakota, No. 1.—Operator, Consolidated Coal Company. Mine, Lehigh, at Lehigh, Stark County. Kind of coal, brown lignite, run of mine (forked coal).

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	42.06	42.81	32.64
	Volatile matter	24.55	26.84	29.19
	Fixed carbon	25.73	23.93	26.75
Proximate. / Ultimate.	Ash	7.66	6.42	11.42
Ultimate.	Sulphur	1.13	.96	3.54
	Hydrogen			6.15
	Carbon			39.53
	Nitrogen			.49
	Oxygen			38.87
Calorific value determined:				
	Calories	3,421		3,872
	British thermal units	6,158		6,970

Boiler test: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 5.40 pounds; dry coal consumed per electrical horsepower per hour, 6.47 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.90 pounds.

Briquetting test: All results negative; briquets did not cohere well. A shipment to Magdeburg, Germany, was successfully briquetted by the German presses, the lignite being crushed and dried.

[a] For brief description of the equipment used in these tests see page 6.

North Dakota, No. 2.—Operator, Cedar Coulee Coal Company. From mouth of Cedar Coulee, 4 miles southeast of Williston. Kind of coal, brown lignite, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	41.13	36.13	36.78
	Volatile matter	27.17	29.28	28.16
	Fixed carbon	26.34	29.55	29.97
	Ash	5.36	5.04	5.09
Ultimate.	Sulphur	.72	.59	.48
	Hydrogen	....	6.60	6.93
	Carbon	....	42.00	41.87
	Nitrogen	....	.73	.69
	Oxygen	....	45.04	44.94
Calorific value determined:				
	Calories	3,603	4,070	4,002
	British thermal units	6,485	7,326	7,204

Producer-gas tests: Dry coal consumed per electrical horsepower per hour, 1.80 and 2.29 pounds.

North Dakota, No. 3.—Operator, Washburn Lignite Coal Company. Mine, Wilton, 1 mile east of Wilton, McLean County. Kind of coal, brown lignite, lump.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	40.53	41.88	35.96
	Volatile matter	27.05	26.11	31.92
	Fixed carbon	27.37	26.73	24.37
	Ash	5.05	5.28	7.75
Ultimate.	Sulphur	.76	.96	1.15
	Hydrogen	....	....	6.54
	Carbon	....	....	41.43
	Nitrogen	....	....	1.21
	Oxygen	....	....	41.92
Calorific value determined:				
	Calories	3,691	....	3,927
	British thermal units	6,644	....	7,069

Boiler test, rocking grate used: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 6.45 pounds; dry coal consumed per electrical horsepower per hour, 5.41 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 2.08 pounds.

OHIO.

Total production in 1905, 25,552,950 short tons; spot value, $26,486,740.

The coal production of Ohio in 1905 did not show a rate of increase corresponding to those made in the adjoining and competitive States of Pennsylvania and West Virginia, the gain over 1904 amounting to 1,152,730 short tons, or 4.8 per cent. This was, moreover, accomplished at a considerable sacrifice in values, for the average price declined from $1.09 in 1905 to $1.04 in 1904, and the total value fell off from $26,579,738 to $26,486,740, a loss of $92,998. Of the 29 coal-producing counties in the State 14 reported an increased production in 1905, while 15 showed a decreased output. The principal increases were made in Belmont County, whose output showed a gain of 785,630 short tons, or 25 per cent, with a decline from 95 cents to 89 cents in the average price, and in Jefferson County, which increased 853,254 short tons, or 35 per cent, with a decline from $1 to 96 cents in the average price. Decreases were shown in two of the counties comprising the well-known Hocking district, Athens County's production increasing 3,762 tons, while Hocking's decreased 253,814 tons, and Perry's 138,675 tons. The total decrease for the district was 388,727 tons.

The number of men employed decreased from 43,634 in 1904 to 43,399 in 1905, the average number of working days being 175 in 1904 and 176 in 1905, indicating an improvement in the productive capacity of the employees. In fact, the statistics of labor employed show that the average production per man for the year 1905 was 588.8 tons, against 559.2 in 1904, while the average daily tonnage was 3.35, against 3.2. In 1903 41,936 men worked an average of 194 days, the average tonnage per man being 592 for the year and 3.05 per day.

A part of the improved efficiency in 1905 may be ascribed to the increased use of undercutting machines. The statistics for 1905 show that there were 1,041 machines in use during that year, and that 16,888,417 short tons, or 66.1 per cent of the total, was machine-mined, against 13,983,647 tons, or 57.3 per cent of the total, in 1904. Ohio leads all the other coal-producing States in the percentage of the total produced that is mined by the use of machines.

Like the other States where coal mining has been carried on during the last few years under agreements with the United Mine Workers of America the mines of Ohio, with few exceptions, are operated 8 hours a day. In 1905, 524 mines out of a total of 591, giving employment to 41,680 men, out of a total of 43,399, were worked on an 8-hour basis; 7 mines, employing 527 men, worked 9 hours, and 4 unimportant mines worked 10 hours. Ten mines, averaging 11 men each, worked less than 8 hours, and 46 mines, employing a total of 1,077 men, did not report the number of hours per day. Compared with the preceding year, and with the total number of men employed and time worked in 1905, the time lost through labor troubles last year was insignificant. There were suspensions of work at 26 mines in 1905, compared with 90 in 1904. The total number of men on strike in 1905 was 3,250, and the average time lost by each was 15 days, against 11,412 men idle for an average of 45 days in 1904. The aggregate time lost in 1905 was 49,495 days, and in 1904, 514,658 days. The most serious strike in 1905 was at the Roby No. 2 mine, of the Roby Coal Company, in Jefferson County, where 460 men were idle for a period of 6 weeks. Other suspensions were comparatively unimportant. In three instances the difficulties were adjusted in 1 day, and three more in 2 days.

Although there was altogether a total of 131 fatal accidents in and about the mines of Ohio in 1905, all of those which occurred inside the mines resulted in the death of but 1 person each. There were no gas nor dust explosions of any consequence. The total number of men killed inside the mines was 114, and 17 deaths occurred on the outside of the mines. Of the total number of fatalities within the mines, 71 were due to falls of roof, 8 to falls of coal, 13 to mine cars, 4 to mining machines, 6 to electric wires, 4 to premature explosions or windy shots, and 8 to other causes. Of the 17 deaths which occurred on the outside of the mines, 4 were due to a boiler explosion at the Provident mine, in Belmont County, and 4 to an explosion of powder in a blacksmith's shop at the Andre mine, in Perry County. The other 6 were due to miscellaneous causes, 1 at a time.

Mr. W. H. Werker, chief clerk of the department of mines, states that there are only a few properties in the State which generate sufficient fire damp to be considered dangerous mines, and in these the department has been enforcing the strictest rules to prevent the accumulation of gases.

The statistics of production in 1904 and 1905, by counties, with the distribution of the product for consumption, are shown in the following tables:

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	3,242,722	39,486	41,907	....	3,324,115	$3,544,277	$1.07	163	5,527
Belmont	2,936,722	172,615	63,013	....	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	87,973	51,549	....	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	2,326,147	69,489	42,188	....	2,437,824	2,449,232	1.00	144	4,901
Stark	638,341	92,319	37,453	....	768,113	1,433,241	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	15,288	....	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]	271,757	21,448	5,058	....	298,263	421,724	1.41	167	687
Small mines	....	18,681	....	....	18,681	22,423	1.20	....	....
Total	22,563,735	1,420,012	415,517	956	24,400,220	26,579,738	1.09	175	43,634

[a] Morgan, Noble, Scioto, Trumbull, Portage, and Washington.

Coal production of Ohio in 1905, 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	3,262,737	28,781	36,359	....	3,327,877	$3,286,140	$0.99	161	6,014
Belmont	3,758,649	106,889	92,442	....	3,957,980	3,517,078	.89	191	5,112
Carroll	176,295	43,121	8,101	....	227,517	244,454	1.07	175	523
Columbiana	755,520	44,655	10,950	....	811,125	853,378	1.05	220	1,199
Coshocton	346,431	32,811	2,510	....	381,752	426,398	1.12	196	741
Gallia	20,530	5,315	....	....	25,845	30,336	1.17	143	110
Guernsey	2,858,950	11,872	48,882	....	2,919,704	2,639,168	.90	180	3,821
Harrison	324,894	28,263	5,321	....	358,478	315,634	.88	166	608
Hocking	2,159,627	27,619	17,342	....	2,204,588	2,186,636	1.00	195	2,950
Holmes	7,908	13,032	35	....	20,975	27,386	1.31	172	76
Jackson	1,790,113	63,315	35,504	....	1,888,932	2,728,829	1.44	180	4,165
Jefferson	3,020,726	182,692	64,792	1,166	3,269,376	3,150,617	.96	179	4,928
Lawrence	120,968	57,828	750	....	179,546	216,729	1.21	183	489
Mahoning	77,000	37,257	1,881	....	116,138	153,740	1.32	221	231
Medina	34,241	20,592	1,813	....	56,646	81,660	1.44	173	177
Meigs	305,491	40,410	3,290	....	349,191	366,588	1.05	209	686
Muskingum	154,979	43,025	300	....	198,304	213,767	1.08	153	431
Perry	2,197,662	77,069	24,688	....	2,299,418	2,304,457	1.01	146	4,500
Scioto	6,482	1,000	200	....	7,682	11,523	1.50	112	30
Stark	467,358	103,575	27,128	....	598,061	1,125,419	1.88	173	1,654
Summit	99,486	5,857	8,100	....	113,443	162,771	1.43	155	286
Tuscarawas	1,236,320	111,905	15,818	....	1,364,043	1,336,276	.98	183	2,606
Vinton	223,855	560	2,002	....	226,417	301,612	1.33	170	480
Wayne	185,766	1,250	3,521	....	190,537	283,964	1.49	154	608
Other counties[a] and small mines.	420,703	34,688	3,983	....	459,374	522,180	1.14	148	964
Total	24,012,691	1,123,381	415,712	1,166	25,552,950	26,486,740	1.04	176	43,399

[a] Morgan, Noble, Portage, Trumbull, and Washington.

The production by counties during the last five years, with the increases and decreases in 1905, as compared with 1904, is shown in the following table:

Coal production of Ohio, 1901–1905, by counties.

[Short tons.]

County.	1901.	1902.	1903.	1904.	1905.	Increase or decrease in 1905.
Athens	2,968,720	3,319,597	3,424,958	3,324,115	3,327,877	+ 3,762
Belmont	1,506,858	1,997,956	2,725,849	3,172,350	3,957,980	+ 785,630
Carroll	180,773	225,379	254,440	235,010	227,517	− 7,493
Columbiana	734,680	793,858	907,325	802,667	811,125	+ 8,458
Coshocton	413,579	437,784	454,008	340,344	381,752	+ 41,408
Gallia	14,826	21,470	48,948	29,642	25,845	− 3,797
Guernsey	2,287,870	2,655,610	2,776,829	3,124,702	2,919,704	− 204,998
Harrison	79,692	361,492	259,047	264,519	358,478	+ 93,959
Hocking	2,768,772	2,641,141	2,506,410	2,458,402	2,204,588	− 253,814
Holmes	....	14,785	41,338	30,528	20,975	− 9,553
Jackson	2,175,316	2,412,509	2,411,145	1,936,451	1,888,932	− 47,519
Jefferson	1,322,305	1,812,801	2,479,211	2,416,122	3,269,376	+ 853,254
Lawrence	107,216	183,369	228,251	183,604	179,546	− 4,058
Mahoning	109,349	127,747	123,206	87,515	116,138	+ 28,623
Medina	108,684	90,718	132,823	98,433	56,646	− 41,787
Meigs	237,614	339,639	316,888	185,396	349,191	+ 163,795
Morgan	27,276	86,821	93,675	83,800	173,766	+ 89,966
Muskingum	137,670	225,413	281,649	257,498	198,304	− 59,194
Perry	2,446,872	2,743,997	2,731,282	2,437,824	2,299,418	− 138,675
Portage	150,678	100,266	109,794	101,050	84,178	− 16,872
Stark	896,996	1,080,429	910,865	768,113	598,061	− 170,052
Summit	106,988	67,442	42,118	89,985	113,443	+ 23,458
Trumbull	8,506	12,030	10,652	12,900	1,875	− 11,025
Tuscarawas	1,510,462	1,578,610	1,279,636	1,552,065	1,364,043	− 188,022
Vinton	46,889	92,441	192,069	206,622	226,417	+ 19,795
Washington	3,010	3,604	3,600	9,550	1,424	− 8,126
Wayne	27,540	78,390	69,870	81,369	190,537	+ 109,168
Noble Scioto	64,675	14,596	a 8,681	90,963	178,050	+ 87,087
Small mines	500,000	(b)	13,536	18,681	27,763	+ 9,082
Total	20,943,807	23,519,894	24,838,103	24,400,220	25,552,950	+1,152,730
Total value	$20,928,158	$26,953,789	$31,932,327	$26,579,738	$26,486,740	− $92,998

a No production in Noble County.
b Small mines production included in county distribution.

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.

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, 1838–1905.

[Short tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1838	119,952	1861	1,150,000	1884	7,640,062
1839	125,000	1862	1,200,000	1885	7,816,179
1840 [a]	140,536	1863	1,204,581	1886	8,435,211
1841	160,000	1864	1.815,622	1887	10,300,708
1842	225,000	1865	1,536,218	1888	10,910,951
1843	280,000	1866	1,887,424	1889	9,976,787
1844	340,000	1867	2,092,334	1890	11,494,506
1845	390,000	1868	2,475,844	1891	12,868,683
1846	420,000	1869	2,461,986	1892	13,562,927
1847	480,000	1870 [a]	2,527,285	1893	13,253,646
1848	540,000	1871	4,000,000	1894	11,909,856
1849	600,000	1872	5,315,294	1895	13,355,806
1850	640,000	1873	4,550,028	1896	12,875,202
1851	670,000	1874	3,267,585	1897	12,196,942
1852	700,000	1875	4,864,259	1898	14,516,867
1853	760,000	1876	3,500,000	1899	16,500,270
1854	800,000	1877	5,250,000	1900	18,988,150
1855	890,000	1878	5,500,000	1901	20,943,807
1856	930,000	1879	6,000,000	1902	23,519,894
1857	975,000	1880 [a]	6,008,595	1903	24,838,103
1858	1,000,000	1881	9,240,000	1904	24,400,220
1859	1,060,000	1882	9,450,000	1905	25,438,755
1860 [a]	1,265,600	1883	8,229,429		

[a] United States census, fiscal year.

RESULTS OF TESTS OF OHIO COALS.

The more important features of the results of tests made on Ohio coals at the Geological Survey coal testing plant [a] at St. Louis, Mo., are briefly summarized below. For more detailed reports see Professional Paper No. 48 and Bulletin No. 290 of the United States Geological Survey.

Ohio, No. 1.—Operator, Superior Coal Company. Mine, No. 10, 9 miles southeast of Wellston, Jackson County. Seam, No. 4. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	8.45	7.50	7.71
	Volatile matter	41.27	39.25	38.32
	Fixed carbon	43.55	42.74	42.02
	Ash	6.73	10.51	11.95
Ultimate.	Sulphur	3.10	5.44	4.61
	Hydrogen			5.41
	Carbon			62.49
	Nitrogen			1.11
	Oxygen			14.43
Calorific value determined:				
	Calories	6,805		6,397
	British thermal units	12,249		11,515

Boiler tests, rocking grate used: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 8.05 and 8.31 pounds; dry coal consumed per electrical horsepower per hour, 4.34 and 4.20 pounds.

Coking test: Crushed washed coal burned 48 hours yielded 57.08 per cent of silvery, fingered coke, high in ash and sulphur.

Washing test. Coal crushed to 2 inches, modified Stewart jig used; ash, before washing, 11.95 per cent; after, 8.57 per cent; sulphur, before, 4.61 per cent; after, 3.72 per cent.

Ohio, No. 2.—Operator, Superior Coal Company. Mine, No. 10, 9 miles southeast of Wellston, Jackson County. Seam, No. 5. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	9.38	8.95	9.01
	Volatile matter	36.74	37.82	35.85
	Fixed carbon	46.26	43.89	43.80
	Ash	7.62	9.34	11.34
Ultimate.	Sulphur	4.08	4.41	4.02
	Hydrogen			5.38
	Carbon			62.79
	Nitrogen			1.20
	Oxygen			15.27
Calorific value determined:				
	Calories	6,610		6,386
	British thermal units	11,898		11,495

Boiler test, washed coal: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 8.16 pounds; dry coal consumed per electrical horsepower per hour, 4.28 pounds.

Coking test: Crushed washed coal burned 59 hours gave 49.80 per cent dull-gray soft coke, high in sulphur.

Washing test: Coal crushed to 2 inches, modified Stewart jig used; raw coal, ash, 11.34 per cent; sulphur, 4.02 per cent; washed coal, ash, 7.42 per cent; sulphur, 2.95 per cent.

[a] For brief description of the equipment used in these tests see p. 6.

Ohio, No. 3.—Operator, Ohio Mining and Manufacturing Company. Mine, Gosline and Barbour, at Shawnee, Perry County. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	10.78	9.79	9.90
	Volatile matter	34.86	35.74	33.66
	Fixed carbon	48.23	48.46	44.86
	Ash	6.13	6.01	11.58
Ultimate.	Sulphur	1.11	1.43	1.81
	Hydrogen	....	....	5.28
	Carbon	....	....	63.06
	Nitrogen	....	....	1.23
	Oxygen	....	....	17.04
Calorific value determined:				
	Calories	6,663	....	6,265
	British thermal units	11,993	....	11,277

Boiler test, with rocking grate: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 8.97 pounds; dry coal consumed per electrical horsepower per hour, 3.89 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.39 pounds.

Coking test: Crushed washed coal burned 60 hours yielded no coke.

Washing test: Coal crushed to 2 inches, modified Stewart jig used; raw coal, ash, 11.58 per cent; sulphur, 1.81 per cent; washed coal, ash, 7.74 per cent; sulphur, 1.36 per cent.

Ohio, No. 4.—Operator, United States Coal Company. Mine, Crown Hollow, at Bradley, Jefferson County. Kind of coal, bituminous, over ¾-inch bar screen ("¾-inch").

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	4.06	4.20	3.53
	Volatile matter	38.49	37.16	37.45
	Fixed carbon	49.70	51.13	49.90
	Ash	7.75	7.51	9.12
Ultimate.	Sulphur	3.67	3.22	3.47
	Hydrogen	....	....	5.15
	Carbon	....	....	71.66
	Nitrogen	....	....	1.31
	Oxygen	....	....	9.29
Calorific value determined:				
	Calories	7,304	....	7,262
	British thermal units	13,147	....	13,072

Boiler test, with raw coal: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 8.62 pounds; dry coal consumed per electrical horsepower per hour, 4.05 pounds. With washed coal: Water evaporated, 8.95 and 9 pounds; coal consumed, 3.90 and 3.88 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.27 pounds.

Coking test: Crushed raw coal burned 45 hours yielded 67.70 per cent good, heavy, silvery coke, high in ash and sulphur.

Washing test: Coal crushed to 2 inches and washed in modified Stewart jig showed little reduction in ash and sulphur.

Ohio, No. 5.—Operator, Glens Run Coal Company. Mine, No. 1, at Rush Run, Jefferson County. Kind of coal, bituminous, over ¾-inch bar screen.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	4.69	4.99	4.34
	Volatile matter	35.57	35.33	35.53
	Fixed carbon	53.73	53.98	52.83
	Ash	6.01	5.70	7.30
Ultimate.	Sulphur	1.54	.95	1.72
	Hydrogen			5.21
	Carbon			72.65
	Nitrogen			1.42
	Oxygen			11.70
Calorific value determined:				
	Calories	7,403		7,321
	British thermal units	13,325		13,178

Boiler test: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 8.85, 8.87, 9.25, and 9.07 pounds; dry coal consumed per electrical horsepower per hour, 3.95, 3.94, 3.77, and 3.85 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.20 pounds.

Coking test: Crushed raw coal burned 55 hours gave 63.83 per cent good, strong, silvery coke, suitable for blast furnace; by washing coal would probably get good foundry coke.

Ohio, No. 6.—Operator, Neff Coal Mining Company. Mine, No. 1, at Neffs, Belmont County. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	3.99	4.06	5.31
	Volatile matter	38.77	39.45	36.72
	Fixed carbon	49.17	50.05	49.45
	Ash	8.07	6.44	8.52
Ultimate.	Sulphur	3.49	3.35	3.33
	Hydrogen			5.39
	Carbon			70.71
	Nitrogen			1.12
	Oxygen			10.93
Calorific value determined:				
	Calories	7,279		7,135
	British thermal units	13,102		12,843

Boiler test: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 9.02 pounds; dry coal consumed per electrical horsepower per hour, 3.87 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.25 pounds.

Washing test: Washing in modified Stewart jig does not materially reduce sulphur and ash.

Coking test: Washed and unwashed coal yield heavy, good-textured, silvery coke, high in sulphur. Coke from washed coal not as good physically as from unwashed.

Ohio, No. 7.—Operator, Forsythe Coal Company. Mine, Forsythe, near Danford, Guernsey County. Kind of coal, bituminous, over 1¼-inch bar screen.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	6.28	5.80	6.65
	Volatile matter	35.81	36.89	33.94
	Fixed carbon	50.61	50.73	48.86
	Ash	7.30	6.58	10.55
Ultimate.	Sulphur	3.55	2.62	3.13
	Hydrogen			5.30
	Carbon			67.38
	Nitrogen			1.20
	Oxygen			12.44
Calorific value determined:				
	Calories	7,056		6,766
	British thermal units	12,701		12,179

Boiler tests: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 9 and 8.76 pounds; dry coal consumed per electrical horsepower per hour, 3.88 and 3.99 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.58 pounds.

Coking test: Washed and unwashed coal yielded light gray, silvery coke, high in sulphur and ash; quality not improved by washing coal.

Washing test: Crushed coal washed in modified Stewart jig, ash reduced from 10.55 to 6.37 per cent; sulphur from 3.13 to 2.16 per cent.

Ohio, No 8.—Operator, Upson Coal and Mining Company. Mine, Dixie, at Dixie, Perry County. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	8.92	8.87	7.55
	Volatile matter	38.58	39.32	38.00
	Fixed carbon	46.65	47.81	46.08
	Ash	5.85	4.00	8.37
Ultimate.	Sulphur	3.00	1.74	2.84
	Hydrogen			5.48
	Carbon			67.02
	Nitrogen			1.29
	Oxygen			15.00
Calorific value determined:				
	Calories	6,849		6,738
	British thermal units	12,328		12,128

Boiler test with rocking grate: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 9.01 pounds; dry coal consumed per electrical horsepower per hour, 3.88 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.42 pounds.

Coking test: Raw coal gives silvery, fine-fingered coke, high in ash and sulphur; coke from washed coal no better.

Washing test: Slight reduction in ash and very little in sulphur by washing in modified Stewart jig.

Ohio, No. 9.—Operator, Gallia Mining Company. Mine, at Clarion, Vinton County. Kind of coal, bituminous, over 1¼-inch screen (lump), and through 1¼-inch screen (nut and slack).

Chemical analyses.

		Mine samples.		Car sample, lump.	Car sample, nut and slack.
Proximate.	Moisture	6.79	7.38	5.59	8.10
	Volatile matter	40.01	41.60	36.86	36.87
	Fixed carbon	45.54	44.86	49.26	43.10
Proximate. / Ultimate.	Ash	7.66	6.16	8.29	11.93
Ultimate.	Sulphur	3.34	2.77	3.15	3.35
	Hydrogen			4.88	5.15
	Carbon			69.76	63.54
	Nitrogen			1.18	1.06
	Oxygen			12.74	14.97
Calorific value determined:					
	Calories	6,952		7,096	6,424
	British thermal units	12,514		12,773	11,563

Boiler test, with slack and nut, washed: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 9.30 pounds; with slack and nut washed and dried, water evaporated, 9.11 and 9.04 pounds; coal consumed per electrical horsepower per hour, 3.83 and 3.86 pounds; with unwashed lump, best of four tests, water evaporated, 9.22 pounds; coal consumed per electrical horsepower per hour, 3.79 pounds. Dry coal consumed per electrical horsepower per hour, 3.75 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.32 pounds.

Coking test: Crushed nut and slack burned 53 hours made 60.25 per cent dull gray, good weight coke, high in ash and sulphur; washing coal did not reduce sulphur sufficiently.

Washing test: Nut and slack washed in modified Stewart jig showed reduction of ash from 11.93 to 7.45 per cent and sulphur from 3.35 to 2.88 per cent.

OREGON.

Total production in 1905, 109,641 short tons; spot value, $282,495.

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 Lehalem field, in Clatsop and Tillamook counties; 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 deen 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 production in 1905 was not quite equal to that of the preceding year, when it reached a total of 111,540 short tons, the maximum output in the history of the State. Until 1904 the larger part of the production of Oregon was from the Newport mine but the last two years have witnessed a considerable development at the Beaver Hill mines, which were opened in 1895. The higher value shown for 1905, as compared with the two preceding years, was due to an advance in price reported for the Beaver Hill product.

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 table:

Distribution of the coal product in Oregon, 1892–1905.

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 employees.	Average number of days worked.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*				
1892	31,760	2,353	548	34,661	$148,546	$4.29	90	120
1893	37,835	3,594	254	41,683	164,500	3.57	110	192
1894	45,068	2,171	282	47,521	183,914	3.87	88	243
1895	68,108	5,294	283	73,685	247,901	3.36	414	69
1896	88,116	12,951	654	101,721	294,564	2.90	254	191
1897	92,921	5,207	9,161	107,289	291,772	3.09	375	200
1898	54,305	3,290	589	58,184	212,184	3.65	142	199
1899	78,608	6,656	1,624	86,888	260,917	3.00	124	238
1900	48,160	9,590	1,114	58,864	220,001	3.74	141	273
1901	53,472	14,531	1,008	69,011	173,646	2.52	187	228
1902	42,591	11,232	11,825	65,648	160,075	2.44	265	234
1903	67,192	9,848	14,104	91,144	221,031	2.43	235	258
1904	79,293	13,968	18,279	111,540	243,588	2.18	334	284
1905	84,258	7,883	17,500	109,641	282,495	2.58	316	242

Coal was first noted in the Coos Bay region about 50 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 Beaver Hill mine, opened in 1905, was at first rather an uncertain factor, but is now an important producer. 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 4 years only—1896, 1897, 1904, and 1905—the maximum being obtained in 1904, when it reached 111,540 tons.

Coal production of Oregon, 1880–1905.

[Short tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1880	*a* 43,205	1889	64,359	1898	58,184
1881	33,600	1890	61,514	1899	86,888
1882	35,000	1891	51,826	1900	58,864
1883	40,000	1892	34,661	1901	69,011
1884	45,000	1893	41,683	1902	65,648
1885	50,000	1894	47,521	1903	91,144
1886	45,000	1895	73,685	1904	111,540
1887	37,696	1896	101,721	1905	109,641
1888	75,000	1897	107,289		

a United States census, fiscal year.

PENNSYLVANIA.

Total production in 1905, 196,073,487 short tons; spot value, $255,269,508.

Anthracite: Total production in 1905, 69,339,152 long tons; spot value, $141,879,000.

Bituminous: Total production in 1905, 118,413,637 short tons; spot value, $113,390,508.

In the production of both anthracite and bituminous coal in 1905, Pennsylvania exceeded any previous record and established a new high-water mark. The largest output obtained prior to 1905 was won in 1903, when in order to make up for the shortage resulting from the strike in the anthracite regions in 1902 the production was unusually augmented and reached the then unprecedented total of 177,724,246 short tons, which included 103,117,178 short tons of bituminous coal, and 74,607,068 short tons (66,613,454 long tons) of anthracite. Under more normal conditions which prevailed in 1904, the total production receded to 171,108,976 short tons, of which 97,952,267 short tons were bituminous coal and 73,156,709 short tons (65,318,490 long tons) were anthracite.

Compared with the production of 1904, the output in 1905 exhibits an increase of 24,964,511 short tons, or 14.6 per cent in quantity, and of $21,861,269, or 9 per cent in value, while as compared with 1903 the production in 1905 shows a gain of 18,349,241 short tons, or 10.4 per cent in quantity, and a loss of $18,519,699, or 6.7 per cent in value, the smaller value in the later year being due to the high prices which obtained in 1903 as a result of the shortage previously referred to.

Of the increase in 1905 over 1904, 20,475,350 short tons were bituminous coal, while anthracite increased 4,020,662 long tons, or 4,503,141 short tons. The value of the bituminous product increased $18,962,289 and that of anthracite $2,904,980. The average price for Pennsylvania bituminous coal was about the same in 1905 as in 1904, while that of anthracite declined from $2.35 to $2.25 per long ton, this decline being in large part due to the increasing consumption of smaller sizes which bring much lower prices than the domestic grades of nut, range, and furnace.

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 5-year periods for the 25 years from 1876 to 1905. It will be seen from this table that the average production of anthracite during the 5 years 1901–5 was 2.59 times the average yearly production from 1876 to 1880, and that bituminous production for the later period was nearly 7.5 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 1905 bituminous production was 4.08 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 bituminons 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
1901–1905	66,853,778	272,542,704

Until 1902 Pennsylvania had enjoyed uninterruptedly 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. The increase of nearly 25,000,000 tons in 1905 over 1904 has, however, reinstated Pennsylvania in this respect with almost exactly 50 per cent of the total output of the United States. In 1880 Pennsylvania produced 66 per cent of the entire output of the United States, and while the percentage has showed a decreasing tendency since that time the average for the last 24 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, 1880–1905.

[Short tons.]

Year.	Total United States.	Pennsylvania.	Percentage of Pennsylvania to total.	Year.	Total United States.	Pennsylvania.	Percentage of Pennsylvania to total
1880	71,481,569	47,529,711	66	1893	182,352,774	98,038,267	54
1881	85,881,030	54,320,018	63	1894	170,741,526	91,833,584	54
1882	103,285,789	57,254,507	55	1895	193,117,530	108,216,565	56
1883	115,212,125	62,488,190	54	1896	191,986,357	103,903,534	54
1884	119,735,051	62,404,488	52	1897	200,223,665	107,029,654	53
1885	110,957,522	62,137,271	56	1898	219,976,267	118,547,777	54
1886	112,743,403	62,857,210	56	1899	253,741,192	134,568,180	53
1887	129,975,557	70,372,857	54	1900	269,684,027	137,210,241	51
1888	148,659,402	77,719,624	52	1901	293,299,816	149,777,613	51
1889	141,229,514	81,719,059	58	1902	301,582,348	139,947,962	46
1890	157,788,657	88,770,814	56	1903	357,356,416	177,724,246	49.7
1891	168,566,668	93,453,921	55	1904	351,816,398	171,094,996	49
1892	179,329,071	99,167,080	55	1905	392,919,701	196,073,487	50

PENNSYLVANIA ANTHRACITE.

By William W. Ruley.

In the report on the production of anthracite coal for the year 1904 comment was made on the continuance of the prosperity in this industry, which was so marked during the year 1903, and it was noted that the severity of the winter of 1903–4 had so depleted the stocks of anthracite that the year 1904 started under exceptionally favorable conditions, and the tonnage, although not so heavy as in 1903, was satisfactory.

A repetition during the winter of 1904–5 of the weather conditions of the previous winter resulted in an exceptionally large use of anthracite in the first three months of 1905, with a consequent stimulus to the trade for the entire year. The large tonnage in 1905—the greatest, in fact, in the history of the anthracite industry—is partly accounted for by the experience of the trade in the preceding severe winters, and partly by the fear of impending trouble in the anthracite regions on the 1st of April, 1906, this fear causing both dealers and consumers to lay in heavier stocks than they would have done had there been no danger of a stoppage in the production. The result has been that both dealers and consumers had on hand a considerably larger stock of coal on the 1st of January, 1906, than at the corresponding time in 1905. The extreme mildness of the winter of 1905–6, as compared with the two preceding ones, has, of course, resulted in a much smaller consumption of coal and has accentuated the condition above mentioned.

The whole subject of marketing anthracite coal is an interesting one. On account of the greater expense of mining anthracite as compared with bituminous coal, it is impossible to carry it great distances to compete with bituminous coals in markets where the people are accustomed to bituminous coal and can get it at much less cost. The result of this has been practically to confine the consumption of anthracite to the States along the Atlantic seaboard. It is found that nearly 82 per cent of the total shipments of anthracite is consumed in the New England States, New York, Pennsylvania, and New Jersey; in addition, 3.4 per cent goes to the Southern States, practically all of this southern trade being distributed along the Delaware and Maryland Peninsula, to Baltimore and Washington, and to points within easy reach of the coast; and 3.56 per cent goes to Canada, by tidewater from Philadelphia or New York, by crossing the lakes, or by all-rail routes connecting with the initial anthracite lines. It will thus be seen that only about 11 per cent of the entire anthracite shipments reaches territory west of Buffalo, Erie, Pittsburg, or corresponding points.

The distribution to the geographical sections is as follows:

Distribution of anthracite coal in 1904 and 1905.

	1904.		1905.	
	Long tons.	*Percentage.*	*Long tons.*	*Percentage.*
Pennsylvania, New York, and New Jersey	38,376,089	66.75	41,501,569	67.58
New England States	8,242,087	14.34	8,692,504	14.15
Southern States	2,061,810	3.58	2,080,088	3.39
Western States	6,579,644	11.44	6,904,314	11.25
Pacific coast	4,500	.01	1,743	.00
Dominion of Canada	2,193,746	3.82	2,187,450	3.56
Foreign ports	34,646	.06	42,533	.07
Total	57,492,522	100.00	61,410,201	100.00

In spite of the anthracite-consuming territory being so circumscribed geographically, this territory is rich and populous, and it would seem, from a study of the great growth of the bituminous production, that anthracite had scarcely had its proportionate growth. It should be borne in mind, however, that there are certain competitive conditions surrounding this industry which curtail the increased consumption naturally to be expected with the growing population.

Even the casual observer does not need to be told of the great increase in the use of gas and oil for fuel. The convenience and cleanliness of gas, and the comfort with which it can be used in summer, has resulted in the installation of hundreds of thousands of gas ranges and heaters in the anthracite-consuming territory. A great impetus in this direction was given during the strike of 1902, and what was then done as the result of necessity has continued and grown on account of its convenience.

In addition to these obvious factors affecting the consumption of anthracite coal, there are many other influences which tend to curtail the demand for this product. For instance, in many settlements, especially recent ones, central heating plants have been established. These produce and supply heat at reasonable rates to all houses equipped for such service, thus greatly diminishing the demand for anthracite in these localities, if not (as is the case where bituminous coal is used in these plants) cutting it off altogether. In these cities, too, the growing tendency of people to live in apartment houses is producing the same effect.

These and other more obscure causes tend to limit what would be considered the natural increase in the demand for this product.

It must not be supposed, however, that the anthracite trade has not shown a substantial growth during the last fifteen years, even though it seems small compared with the great increase in the production of bituminous coal. In 1897, when the opinion in the trade respecting the future of this industry was rather gloomy, the writer, in his report to the Survey, expressed himself as follows:

Note is made in the beginning of this report of the falling off in tonnage for the year 1897 as compared with 1896, and the significance of the reduced production is accentuated when comparison is made with the bituminous coal production in 1897. With very few exceptions, the coal-producing States show an increase over 1896, which in some cases is large. In Pennsylvania this increase amounted to 4,500,391 long tons, while the increase of bituminous coal production in the United States for the year 1897 over 1896 was 8,908,252 long tons, compared with a decrease of 1,709,213 tons in the production of anthracite.

What conclusion is to be drawn from these facts and figures? It has been persistently contended by those who think they see the ultimate doom of the anthracite industry that this decrease in production indicates the encroachment of two competitive forces which will ultimately result in the undoing of anthracite. The first of these is the competition of bituminous coal with the small sizes of anthracite for steam purposes. That such competition exists and that the bituminous coal often has the better of it can not be doubted, but that bituminous coal will completely displace the small sizes of anthracite in the steam-coal market seems improbable, since the latter is used in thousands of places where the former coal would be altogether undesirable. The second of these factors is the growing use of gas as a substitute for coal in domestic uses. Unquestionably the use of gas for cooking and heating purposes in private houses is increasing, but that the domestic market for anthracite coal will be destroyed by it is altogether a different proposition. Those who contend that these factors will permanently narrow the market for anthracite seem to forget that the market for fuel is continually expanding and demanding more and more varied means of supply. It has been the almost universal experience that in a broad field the introduction of new methods and new materials has resulted not in doing away with the old, but in modifying and sometimes actually increasing their use and at the same time providing for the new by opening up new avenues of demand. When gas was introduced the prediction was made that it would altogether supersede oil, but the oil industry continued to grow. When electric light was first introduced it was to do away with gas, but gas companies were never so prosperous as they are to-day.

So it is with anthracite coal. It has a place in the economy of the world to-day, and while of course its market will not grow to the same extent as if it had no competition, one would not be judging the present by past experience if he predicted any great contraction of the anthracite market, but should rather expect a reasonable expansion as the business of the country regains its normal condition. In fact, it would not be fair to judge of the future market of any commodity by the experience of the last few years, which have been years of universal business depression, but it would be more logical to infer that with the natural expansion and growth of trade under healthful conditions the anthracite trade will come in for a share, at least, of the improvement and increase.

It is interesting to note to what extent this opinion has been borne out by examining the present conditions in the trade in the section of territory already outlined—the New England States, New York, Pennsylvania, and New Jersey.

In 1891 the total shipments of anthracite amounted to 40,448,336 long tons, and of this quantity about 77 per cent went to the territory mentioned, or a tonnage of over 31,000,000. The population of these States in 1891 was approximately 17,600,000, which would indicate a per capita consumption of anthracite of about 1.71 tons. In 1905 the population of these States was about 23,000,000, and the shipments of anthracite to this district amounted to over 50,000,000 long tons, or a per capita consumption of 2.18 tons, an increase of nearly half a ton for each inhabitant.

This increase, it is true, is largely accounted for by the great increase in the quantity of small sizes of coal shipped in 1905 as compared with 1891. In the earlier year the amount of pea and smaller sizes shipped was 9,965,010 long tons, and as this was practically all consumed in the territory above mentioned, it should be deducted from the total quantity going to these in order to get the tonnage of domestic sizes consumed, which would be approximately 21,500,000 long tons, or a per capita consumption of domestic sizes of 1.22. In 1905 the quantity of pea and smaller sizes shipped was 23,984,984 long tons, which, deducted from the total of all sizes, would leave 26,209,089 tons of domestic sizes consumed in these States, or a per capita consumption of 1.14 tons.

It may be objected that the above figures do not represent actual consumption, but only shipments to the territory named, and that there was relatively a larger stock of coal on hand at the close of 1905 than at the close of 1891; therefore to test the above result average years have been taken for comparison—that is, an average of the three years ending with 1891 has been compared with an average of the three years ending with 1905. The comparison of these average years may be considered a fair one, as the average stock on hand in the 1889–1890–1891 period was probably as large relatively as that for the 1903–1904–1905 period.

The results do not differ materially from the comparison of 1891 and 1905.

They can be stated as follows:

	Average of years 1889–1890–1891.	Average of years 1903–1904–1905.
	Long tons.	*Long tons.*
Per capita consumption, all sizes	1.67	2.11
Per capita consumption, large sizes	1.17	1.11
Per capita consumption, small sizes	.50	1.00

It will thus be seen that the relative use of anthracite in the principal consuming States is greater than it was fifteen years ago if all sizes of anthracite be considered, and not much less if only prepared sizes are included, in spite of the greatly increased use of substitutes for this fuel.

This review would not apply to that part of the product going to the extreme North into Canada or to the extreme South and West, as the farther it is moved from the source of supply the more its use becomes a matter of luxury and not necessity, and the more it yields in competition with cheaper fuels produced locally.

As noted in the discussion of the condition of the anthracite trade, the production for the year 1905 was the largest on record, amounting to 69,339,152 long tons. Of this, 61,654,432 tons were shipped to market, 1,402,644 tons were sold about the mines locally, and 6,282,076 tons were used for steam and heat. In connection with this total product and the quantity shipped it should be noted that 2,777,337 long tons were reclaimed from the culm banks. This quantity, although large, is relatively and actually smaller than for the year 1904. The maximum quantity was gained from this source in 1903, when it reached 3,563,269 long tons. This is of course nearly all small-sized coal, used for steam purposes, only a very small portion being larger than pea. The following table shows the shipments from washeries from 1890 to 1905, inclusive, compared with total shipments:

Shipments of anthracite from washeries and total shipments, 1890–1905.

[Long tons.]

Year.	Shipments from washeries.	Total shipments.	Percentage of washery output to total shipments.
1890	41,600	36,615,459	0.11
1891	85,702	40,448,336	.21
1892	90,495	41,893,320	.22
1893	245,175	43,089,537	.57
1894	634,116	41,391,200	1.53
1895	1,080,800	46,511,477	2.52
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	3,563,269	59,362,831	6.00
1904	2,800,466	57,492,522	4.87
1905	2,777,337	61,410,201	4.52

In addition to this coal a considerable percentage of fresh-mined coal has no other market than for steam purposes, and the proportion of these small sizes has been steadily increasing, as will been seen from the following table:

Shipments of anthracite, according to sizes, 1890–1905.

[Long tons.]

Year.	Sizes above pea.		Pea and smaller.		Total shipments.
	Quantity.	Percentage.	Quantity.	Percentage.	
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
1905	37,425,217	60.9	23,984,984	39.1	61,410,201

In this table, which shows separately from 1890 to 1905, inclusive, sizes above pea, and pea and smaller, it will be noted that the latter division has increased from 23.1 per cent in 1890 to 39.1 per cent in 1905. This increase can not be accounted for by the increase in washery product. For instance, in 1903 the percentage of pea and smaller was 36.43 per cent, and in that year the shipments from washeries amounted to 3,563,269 tons, while in 1905 the shipments from washeries had fallen off to 2,742,815 tons. It appears from this that the actual increase in these small sizes from 1903 to 1905 was 3,094,967 tons, and at the same time there was a decrease in sizes above pea of 261,665 tons.

If these two years be taken and the washery product be eliminated, the production of pea and smaller will be found to be 18,147,202 tons in 1903 and 21,242,169 tons in 1905. This is illustrated by the following table:

Total shipments of anthracite coal and washery product for year 1905, compared with 1903, divided to show large and small sizes.

[Long tons.]

Year.	Total shipments.		Washery product.		Total shipments, less washery product.	
	Sizes above pea.	Pea and smaller.	Sizes above pea.	Pea and smaller.	Sizes above pea.	Pea and smaller.
1903	37,738,510	21,624,321	86,150	3,477,119	37,652,360	18,147,202
1905	37,425,217	23,984,984	34,522	2,742,815	37,390,695	21,242,169
Increase or decrease.	−313,293	+2,360,663	−51,628	−734,304	−261,665	+3,094,967

All the causes of this increase in the smaller sizes are not easily explained, but the results are readily apparent, affecting as they do the marketing of a large part of the product and the average price received for the whole, first, by throwing on the market a relatively larger proportion of the anthracite product in competition with bituminous coal for steam purposes, and, second, which naturally follows, by reducing the average price received for all sizes of anthracite.

In the table given below are shown the total production of anthracite, its value at the mines, the average number of men employed, and the average number of days worked for each of the last five years:

Statistics of anthracite production, 1901–1905.

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
1905	69,339,152	141,879,000	2.25	165,406	218

In the valuation of the product the coal used for steam and heat at the mines is not considered, as it is largely culm and dirt and would not be marketable.

In the following tables is shown the production of the several counties embraced in the anthracite fields, divided to show the quantity of coal shipped, the coal sold locally, and the quantity used for steam and heat.

Anthracite production in 1904, by counties.

[Long tons.]

County.	Shipments.	Sold to local trade and employees.	Used at mines for 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

Anthracite production in 1905, by counties.

[Long tons.]

County.	Shipments.	Sold to local trade and employees.	Used at mines for steam and heat.	Total.
Susquehanna	563,882	8,803	34,588	607,273
Lackawanna	16,044,175	384,668	1,097,152	17,525,995
Luzerne	23,405,910	584,890	2,225,718	26,216,518
Carbon	1,910,390	44,117	238,722	2,193,229
Schuylkill	13,734,616	230,383	1,814,416	15,779,415
Columbia	986,592	16,915	94,437	1,097,944
Sullivan	244,231	4,286	25,650	274,167
Northumberland	4,221,377	108,022	590,699	4,920,098
Dauphin	543,259	20,560	160,694	724,513
Total	61,654,432	1,402,644	6,282,076	69,339,152

In order to continue the record of anthracite shipments from the earliest date to the close of 1905, the following table gives the yearly shipments, divided according to the three trade regions. These shipments include only coal loaded on cars for line or tide-water points, and do not include any coal sold locally or used at and about the mines. Neither do they include the shipments from the Sullivan County mines.

Annual shipments from the Schuylkill, Lehigh, and Wyoming regions, 1820–1905.

[Long tons.]

Year.	Schuylkill region.		Lehigh region.		Wyoming region.		Total.
	Quantity.	Percentage.	Quantity.	Percentage.	Quantity.	Percentage.	Quantity.
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

Annual shipments from the Schuylkill, Lehigh, and Wyoming regions, 1820–1905—Cont'd.

[Long tons.]

Year.	Schuylkill region.		Lehigh region.		Wyoming region.		Total.
	Quantity.	Percentage.	Quantity.	Percentage.	Quantity.	Percentage.	Quantity.
1829	79,973	71.35	25,110	22.40	7,000	6.25	112,083
1830	89,984	51.50	41,750	23.90	43,000	24.60	174,734
1831	81,854	46.29	40,966	23.17	54,000	30.54	176,820
1832	209,271	57.61	70,000	19.27	84,000	23.12	363,271
1833	252,971	51.87	123,001	25.22	111,777	22.91	487,749
1834	226,692	60.19	106,244	28.21	43,700	11.60	376,636
1835	339,508	60.54	131,250	23.41	90,000	16.05	560,758
1836	432,045	63.16	148,211	21.66	103,861	15.18	684,117
1837	530,152	60.98	223,902	25.75	115,387	13.27	869,441
1838	446,875	60.49	213,615	28.92	78,207	10.59	738,697
1839	475,077	58.05	221,025	27.01	122,300	14.94	818,402
1840	490,596	56.75	225,313	26.07	148,470	17.18	864,379
1841	624,466	65.07	143,037	14.90	192,270	20.03	959,773
1842	583,273	52.62	272,540	24.59	252,599	22.79	1,108,412
1843	710,200	56.21	267,793	21.19	285,605	22.60	1,263,598
1844	887,937	54.45	377,002	23.12	365,911	22.43	1,630,850
1845	1,131,724	56.22	429,453	21.33	451,836	22.45	2,013,013
1846	1,308,500	55.82	517,116	22.07	518,389	22.11	2,344,005
1847	1,665,735	57.79	633,507	21.98	583,067	20.23	2,882,309
1848	1,733,721	56.12	670,321	21.70	685,196	22.18	3,089,238
1849	1,728,500	53.30	781,556	24.10	732,910	22.60	3,242,966
1850	1,840,620	54.80	690,456	20.56	827,823	24.64	3,358,899
1851	2,328,525	52.34	964,224	21.68	1,156,167	25.98	4,448,916
1852	2,636,835	52.81	1,072,136	21.47	1,284,500	25.72	4,993,471
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

Annual shipments from the Schuylkill, Lehigh, and Wyoming regions, 1820–1905—Cont'd.

[Long tons.]

Year.	Schuylkill region.		Lehigh region.		Wyoming region.		Total.
	Quantity.	Percentage.	Quantity.	Percentage.	Quantity.	Percentage.	Quantity.
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	15,677,753	51.04	30,718,293
1885	9,488,426	30.01	5,898,634	18.65	16,236,470	51.34	31,623,530
1886	9,381,407	29.19	5,723,129	17.89	17,031,826	52.82	32,136,362
1887	10,609,028	30.63	4,347,061	12.55	19,684,929	56.82	34,641,018
1888	10,654,116	27.93	5,639,236	14.78	21,852,366	57.29	38,145,718
1889	10,486,185	29.28	6,294,073	17.57	19,036,835	53.15	35,817,093
1890	10,867,822	29.68	6,329,658	17.28	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
1905	17,703,099	28.83	7,849,205	12.78	35,857,897	58.39	61,410,201
Total	468,501,531	32.65	234,160,762	16.32	732,385,420	51.03	1,435,047,713

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	
	Wilkes-Barre	
	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 somewhat 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.

Total production in 1905, 118,413,637 short tons; spot value, $113,390,507.

The record made in the bituminous coal fields of Pennsylvania was something unprecedented in the history of coal mining. Not only was the production the largest ever obtained in the State, but the increase over the preceding year surpassed all previous records, and was more than the total production of any other State in 1905, with the exception of Illinois, Ohio, and West Virginia. In 1902 when the production of bituminous coal was unduly stimulated by the great strike in the anthracite regions, the output exhibited a gain of 16,268,421 short tons over that of 1901, and this was considered an extraordinary record. In 1905, without any such unusual conditions, the production shows an increase over 1904 of 20,475,350 short tons, an amount larger by more than 2,000,000 tons than the entire bituminous coal product of the State in 1880. That this remarkable increase is due in great measure to the iron industry, which also increased phenomenally last year, is shown by the fact that more than one-third of the gain made in 1905 over 1904 was in the amount of coal made into coke, which increased from 20,868,368 short tons in 1904 to 27,926,282 short tons in 1905, a gain of 7,057,914 tons, or 34.7 per cent. The percentage gain in the total production was 21, while the value increased 20 per cent. The two counties of Fayette and Westmoreland, which embrace the Connellsville coking districts, were responsible for nearly half of the total increase for the State, these two counties alone showing a gain of over 9,300,000 short tons in 1905. Their combined production exceeded by several million tons the total output of Illinois or West Virginia, which rank next to Pennsylvania as coal-producing States. The increased production was, however, distributed generally throughout the State, but in less proportion than in the two counties mentioned. Six other counties, Allegheny, Cambria, Clearfield, Indiana, Somerset, and Washington, each recorded an increase of over 1,000,000 tons, and only two comparatively unimportant counties, Clinton and Lycoming, showed decreases.

Another interesting fact presented by the statistics of bituminous coal production in Pennsylvania in 1905 is that more than two-thirds of the increased production was represented by machine-mined coal. In 1904 there were 3,645 machines reported in use, and the machine-mined product amounted to 35,174,613 short tons, whereas in 1905 there were 4,254 machines in use, and the quantity of coal undercut by machines was 49,335,660 short tons, indicating an increase in 1905 of 609 machines, and of 14,161,047 short tons, or nearly 40 per cent in the output of machine-mined coal. In 1904 35.9 per cent of the total product was machine-mined, while in 1905 the percentage was 41.7.

The number of men employed in the bituminous coal mines of Pennsylvania in 1905 was 143,629, who worked an average of 231 days, compared with 135,100 men for 196 days in 1904, and 129,265 men for 235 days in 1903. The average yearly production per man was 824.4 short tons in 1905, against 724.9 short tons in 1904, and 798 in 1903. The average daily tonnage per man in the three years was, in 1905, 3.57 tons; in 1904, 3.7 tons; in 1903, 3.4 tons.

The majority of the bituminous mines in Pennsylvania are operated on the basis of an 8-hour day. In 1905, 669 out of 1,148 mines, employing 60,297 men, or 41 per cent of the total, worked 8 hours; 221 mines, employing 25,831 men, worked 9 hours, and 177 mines, with 31,175 men, worked 10 hours. Twenty-one mines reported "8 to 9" hours, "8 to 10" hours, and "9 to 10" hours, 48 did not report, and a few reported less than 8 hours.

The amount of time lost by reason of strikes, in 1905, was negligible, being less than 1 per cent of the total time worked and not sufficient to affect the production. The most serious trouble was at the Morris Run mines of the Morris Run Coal Mining Company, in Tioga County, where 800 men were idle for the first 5 months of the year on account of a shut-down which began in April, 1904. This strike was responsible for one-half of all the time lost. A strike of 625 men at the Sterling 1, 2, 3, 5, and 6 mines of the Sterling Coal Company, in Cambria County, lasted 20 days, and at the No. 3 mine of the Merchants' Coal Company, in Somerset County, 125 men were idle for 100 days, the total working time lost in the two instances being the same. These were the most important shut-downs of the year. In all, 5,686 men were idle for an average of 33 days, against 9,336 men idle for an average of 62 days in 1904. The total time lost in 1905 was a little less than half that of the preceding year.

The casualty record for the bituminous mines of Pennsylvania in 1905, as furnished to the writer by Mr. James E. Roderick, chief of the department of mines, at Harrisburg, shows that there were 479 men killed and 1,076 injured. Of the men killed, 255 were married and left fatherless a total of 543 children. The death rate per thousand was 3.33 and the number of tons mined for each life lost was 247,210.

The most serious accident in the bituminous coal mines of Pennsylvania in 1905 was an explosion of gas and dust at the Eleanora shaft of the Rochester and Pittsburg Coal and Iron Company, in Jefferson County, which occurred on April 27 and resulted in the death of 12 persons. On July 6, at the Fuller mine of the Taylor Coke Company, in Fayette County, and explosion of gas killed 6 persons, and on November 13, in the same mine, another explosion resulted in the death of 3 persons. On October 13, at the Clyde mine of the Clyde Coal Company, in Washington County, 6 persons were suffocated by after damp, and on November 15, in the Braznell mine of the Braznell Gas Coal Company, in Washington County, an explosion of fire damp killed 7 miners.

The statistics of production by counties in 1904 and 1905, with the distribution of the product for consumption, are shown in the following tables:

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	1,914,259	37,374	43,693	1,335	1,996,661	1,930,247	.97	223	3,142
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	215,668	430,290	5,882,522	18,688,974	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	11,944	......	......	....
Total	73,569,449	1,521,106	1,979,364	20,868,368	97,938,287	94,428,219	.96	196	135,100

[a] Cameron, Clinton, Greene, and Lycoming.

Bituminous coal production of Pennsylvania in 1905, 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	13,126,235	334,821	201,554	....	13,662,610	$13,064,340	$0.96	195	18,921
Armstrong	2,372,907	58,684	58,879	6,844	2,497,314	2,344,630	.94	244	3,586
Beaver	55,842	26,092	742	....	82,676	92,041	1.11	207	155
Bedford	521,484	6,333	11,087	213,811	752,715	764,573	1.02	203	1,302
Blair	274,534	1,813	4,484	67,918	348,749	384,997	1.10	245	559
Butler	527,373	16,064	7,152	....	550,589	531,244	.96	205	1,094
Cambria	10,059,353	1,010,812	238,152	1,292,574	12,600,891	13,053,476	1.04	227	18,496
Center	805,520	2,526	2,395	....	810,441	734,928	.91	178	1,446
Clarion	690,365	4,948	19,165	....	714,478	657,359	.92	181	1,564
Clearfield	6,808,679	74,299	139,836	225,491	7,248,305	6,596,374	.91	206	11,703
Elk	1,130,259	16,879	24,871	77,328	1,249,337	1,172,626	.94	223	2,126
Fayette	7,393,435	279,640	465,227	16,112,687	24,250,989	22,983,215	.95	267	19,629
Huntingdon	545,126	5,222	8,691	....	559,039	609,935	1.09	227	894
Indiana	4,103,054	17,345	53,949	303,083	4,477,431	3,982,417	.89	254	5,460
Jefferson	4,974,781	18,939	90,157	1,310,108	6,393,985	5,543,388	.87	243	7,919
Lawrence	234,614	23,729	9,127	....	267,470	311,672	1.17	255	470
Mercer	676,022	7,375	24,567	....	707,964	703,015	.99	209	1,327
Somerset	6,142,397	23,241	165,959	81,075	6,412,672	6,691,403	1.04	240	8,326
Tioga	665,869	34,427	6,427	....	706,723	1,006,239	1.42	175	1,694
Washington	10,259,752	56,577	225,539	67,183	10,609,051	9,612,259	.91	208	12,952
Westmoreland	14,227,015	182,826	463,863	8,125,022	22,998,726	21,970,809	.96	258	23,161
Other counties[a] and small mines	423,625	34,136	10,563	43,158	511,482	579,567	1.13	223	845
Total	86,018,041	2,236,728	2,232,586	27,926,282	118,413,637	113,390,507	.96	231	143,629

[a] Cameron, Clinton, Greene, and Lycoming.

The increase or decrease in each county in 1905 as compared with 1904 is shown in the following table, which exhibits also the production by counties during the last five years:

Bituminous coal production of Pennsylvania, 1901–1905, by counties.

[Short tons.]

County.	1901.	1902.	1903.	1904.	1905.	Increase or decrease 1905.
Allegheny	10,307,100	11,919,569	12,689,225	12,291,261	13,496,214	+ 1,204,953
Armstrong	1,555,255	1,793,179	1,920,584	1,996,661	2,497,314	+ 500,653
Beaver	176,012	225,162	180,102	67,923	82,676	+ 14,753
Bedford	500,322	797,248	926,334	540,850	752,715	+ 211,865
Blair	368,779	338,201	309,736	244,932	348,749	+ 103,817
Bradford	22,189	....	....	....	....	....
Butler	269,161	454,166	649,033	497,316	550,589	+ 53,273
Cambria	9,045,201	10,561,835	10,942,496	10,845,560	12,600,891	+ 1,755,331
Center	839,512	1,000,598	759,458	712,036	810,441	+ 98,405
Clarion	354,840	458,221	531,630	551,532	714,478	+ 162,946
Clearfield	5,886,407	7,334,785	7,462,682	5,746,870	7,248,305	+ 1,501,435
Clinton	306,228	365,732	403,543	341,967	296,988	− 44,979
Elk	1,007,314	756,182	1,339,281	1,129,231	1,249,337	+ 120,106
Fayette	16,187,224	18,988,058	19,613,161	19,231,011	24,250,989	+ 5,019,978
Greene	....	25,550	153,000	80,646	105,000	+ 24,354
Huntingdon	374,529	460,485	500,647	487,223	559,039	+ 71,816
Indiana	1,074,260	1,655,281	2,043,140	2,683,951	4,477,431	+ 1,793,480
Jefferson	5,806,568	6,083,494	6,474,764	6,043,564	6,393,985	+ 350,421
Lawrence	171,959	212,445	232,992	182,662	267,470	+ 84,808
Lycoming	107,095	112,820	57,030	78,837	33,844	− 44,993
Mercer	577,338	628,713	704,747	619,648	707,964	+ 88,316
Somerset	4,831,660	5,911,326	5,957,751	5,317,161	6,412,672	+ 1,095,511
Tioga	861,072	1,149,849	905,688	616,828	706,723	+ 89,895
Washington	5,910,621	8,529,954	9,216,267	8,900,254	10,762,627	+ 1,862,373
Westmoreland	15,165,300	18,811,511	19,127,904	18,688,974	23,011,546	+ 4,322,572
Small mines	600,000	(a)	b 15,983	b 41,389	b 75,650	+ 34,261
Total	82,305,946	98,574,367	103,117,178	97,938,287	118,413,637	+ 20,475,350
Total value	$81,397,586	$106,032,460	$121,752,759	$94,428,219	$113,390,508	+$18,962,289

a Small mines production included in county distribution.
b Includes production of Cameron County.

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 number of canoe-shaped troughs extending northeast and southwest. There are six or more of these troughs, and they lie at successfully lower levels in going toward Ohio River from either the east or the west, the whole tending to form a major shallow trough, whose axis runs roughly from Pittsburg to Huntington, W. Va. The folds diminish in strength in going westward from the Allegheny front. Around the rim of the major trough occur the outcrops of the lower measures, while in the center the lower measures are deeply buried, and the exposed rocks belong to the upper measures.

The coal-bearing rocks all belong to the Pensylvanian series, and have a total thickness in the southwest corner of the State of about 2,600 feet. The great bulk of the coal mined comes from the Allegheny and Monongahela formations, formerly known as the Lower and Upper Productive Measures. Below the Allegheny formation is the Pottsville, containing the Sharon and the Mercer coals, which reach workable thickness only very locally. The Allegheny or Lower Productive Measures, with a thickness of from 250 to 350 feet, contain at least seven coal horizons, all of which yield workable coal locally. They are called, beginning at the bottom, the

Brookville, Clarion, Lower Kittanning, Middle Kittanning, Upper Kittanning, Lower Freeport, and Upper Freeport coals. It is now definitely recognized that the coals at these horizons do not occur in continuous beds, and in many cases not in exactly the same horizons. As a rule, they are not characterized by details of section, roof, or floor, so that they can not be clearly recognized, except over limited parts of the field. No one of them is continuously workable, but the Lower Kittanning and Upper Freeport coals are widely workable, and the Lower Freeport has a splendid development over several counties in the northeast part of the field. The Brookville or "A" coal is of workable thickness in spots over a large part of the marginal belt of the Coal Measures, especially in Jefferson, Clearfield, Center, Cambria, and Somerset counties. The Clarion or "A′" coal reaches workable thickness in about the same belt, though the two are seldom of workable thickness in the same section. Both of these coals are apt to be impure when thick. The Lower Kittanning or "B" coal is the most persistent, uniform, and reliable of the Allegheny coals, although it is thinner than the Freeport coals, seldom exceeding a thickness of 4 feet. It is exposed in workable thickness and purity in eleven of the counties. The Middle and Upper Kittanning horizons, "C" and "C′," contain but little workable coal, though the Upper Kittanning shows cannel coal at a number of points, and stands fourth in productivity. The Lower Freeport coal, "D," is finely developed in Clearfield, Jefferson, Indiana, and Cambria counties; in the well-known Moshannon (Clearfield), Reynoldsville-Punxsutawney, and Barnesboro-Patton basins. Over most of the rest of its territory this seam is either worthless or of too low a grade for competition in the present market.

The Upper Freeport, or coal "E," is a variable and complex bed, extending in gross workable thickness over most of its area, although over a considerable part of this territory it is too much broken up and too impure for profitable mining. It appears to be entirely absent in some localities.

As a whole, the Allegheny formation yields about 40 per cent of the total output of bituminous coal in this State.

For about 600 feet above the Upper Freeport bed occurs the Conemaugh formation, or Lower Barren Measures. It contains six or more coals, which, however, are only very locally workable.

Just over the top of this formation comes the Pittsburg coal, the most uniform in quality and thickness, and for a given area the most valuable coal bed in the bituminous field of Pennsylvania. While not of as high a grade as the best of the Allegheny coals to the east, and while varying greatly in quality from east to west, on the whole the Pittsburg coal, on account of its thickness, its regularity, its high grade, and its adaptability for the production of coke and illuminating gas, has long been the most famous bituminous coal seam in America. It is confined to the southwest part of the State. The seam will give 9 feet of available coal over large areas, and seldom runs under 4 feet. Above the Pittsburg coal occur the Redstone, Sewickley, Uniontown, and Waynesburg coals, which are of good workable thickness locally, but in the presence of the great Pittsburg coal are but little mined.

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 table, 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 1,566,632,870 short tons. The anthracite production from 1814 to the close of 1905 amounted to 1,774,623,598 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, 1840–1905.

[Short tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1840 [a]	464,826	1862	4,000,000	1884	28,000,000
1841	475,000	1863	5,000,000	1885	26,000,000
1842	500,000	1864	5,839,000	1886	27,094,501
1843	650,000	1865	6,350,000	1887	31,516,856
1844	675,000	1866	6,800,000	1888	33,796,727
1845	700,000	1867	7,300,000	1889	36,174,089
1846	760,000	1868	7,500,000	1890	42,302,173
1847	399,840	1869	6,750,000	1891	42,788,490
1848	500,000	1870 [a]	7,798,518	1892	46,694,576
1849	750,000	1871	9,040,565	1893	44,070,724
1850	1,000,000	1872	11,695,040	1894	39,912,463
1851	1,200,000	1873	13,098,829	1895	50,217,228
1852	1,400,000	1874	12,320,000	1896	49,557,453
1853	1,500,000	1875	11,760,000	1897	54,417,974
1854	1,650,000	1876	12,880,000	1898	65,165,133
1855	1,780,000	1877	14,000,000	1899	74,150,175
1856	1,850,000	1878	15,120,000	1900	79,842,326
1857	2,000,000	1879	16,240,000	1901	82,305,946
1858	2,200,000	1880 [a]	18,425,163	1902	98,574,367
1859	2,400,000	1881	22,400,000	1903	103,117,178
1860 [a]	2,690,786	1882	24,640,000	1904	97,938,287
1861	3,200,000	1883	26,880,000	1905	118,413,637

[a] United States census, fiscal year.

RESULTS OF TESTS OF PENNSYLVANIA COALS.

The more important features of the results of tests made on Pennsylvania coals at the Geological Survey coal-testing plant[a] at St. Louis, Mo., are briefly summarized below. For more detailed reports see Professional Paper No. 48 and Bulletin No. 290 of the United States Geological Survey.

Pennsylvania No. 2.—Operator, Berwind-White Coal Mining Company. Mine, Eureka, No. 31, at Windber, Somerset County. Seam, B (P). Kind of coal, bituminous.

Chemical analyses.

		Steam test samples.	
Proximate.	Moisture	1.10	0.59
	Volatile matter	15.80	16.61
	Fixed carbon	75.49	76.76
	Ash	7.41	6.04
Ultimate.	Hydrogen	4.20	4.28
	Carbon	81.98	83.94
	Nitrogen	1.36	1.27
	Oxygen	3.56	3.56
	Sulphur	1.49	0.91
	Ash	7.41	6.04
Calorific value determined:			
	Calories	8,055	8,196
	British thermal units	14,499	14,752

Boiler test (better of two trials): Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 9.79 pounds; dry coal consumed per electrical horsepower per hour, 3.57 pounds.

[a] For brief description of the equipment used in these tests see page 6.

Pennsylvania No. 3.—Operator, Pennsylvania Coal Company. Kind of coal, anthracite culm.

Chemical analysis.

		Car sample.
Proximate.	Moisture	5.41
	Volatile matter	7.02
	Fixed carbon	71.79
Proximate. / Ultimate.	Ash	15.78
Ultimate.	Sulphur	.74
	Hydrogen	3.10
	Carbon	72.65
	Nitrogen	.77
	Oxygen	6.96
Calorific value determined:		
	Calories	6,693
	British thermal units	12,047

Boiler test: Water evaporated by 1 pound of dry briquets at and from a temperature of 212° F., 8.26 pounds; dry coal consumed per electrical horsepower per hour, 4.23 pounds.

Briquetting test: A mixture of 90 parts culm, 10 parts of a West Virginia coking coal, and 12½ per cent of a hard pitch made hard, tough briquets of good quality, which burned with little flame; a mixture of 79¾ per cent culm, 10 per cent West Virginia coking coal, and 11¼ per cent of Hoffman patent binder made hard, clean briquets which burned with a long flame; a mixture of 93 per cent culm with 7 per cent soft pitch made clean, smooth briquets having a crushing strength of 17,100 pounds per square inch after exposure to the weather for several months and burning like lump anthracite.

Pennsylvania No. 4.—Operator, Jamison Coal and Coke Company. Mine, Jamison, 4 miles north of Greensburg, Westmoreland County. Kind of coal, bituminous, over 1¼-inch bar screen (lump).

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	2.73	2.80	3.15
	Volatile matter	30.34	30.92	30.27
	Fixed carbon	57.80	58.21	56.17
Proximate. / Ultimate.	Ash	9.13	8.07	10.41
Ultimate.	Sulphur	1.33	.83	1.26
	Hydrogen			4.96
	Carbon			74.33
	Nitrogen			1.43
	Oxygen			7.61
Calorific value determined:				
	Calories	7,563		7,448
	British thermal units	13,613		13,406

Boiler test, with rocking grate, best of three trials: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 9.84 pounds; dry coal consumed per electrical horsepower per hour, 3.55 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.39 pounds.

Pennsylvania No. 5.—Operator, James W. Ellsworth & Co. Mines, No. 1 and No. 2, at Ellsworth, 'ashington County. Kind of coal, bituminous, over ¾-inch bar screen ("¾-inch").

Chemical analyses.

	Mine samples.		Car sample.
Moisture	3.01	2.91	2.46
Volatile matter	33.46	33.70	34.48
Fixed carbon	58.70	57.99	57.01
Ash	4.83	5.40	6.05
Sulphur	.73	1.08	.88
Hydrogen	....	....	5.26
Carbon	....	....	77.99
Nitrogen	....	....	1.53
Oxygen	....	....	8.29
'alorific value determined:			
Calories	7,887	....	7,785
British thermal units	14,197	....	14,013

Boiler test with raw coal, rocking grate: Water evaporated by 1 pound of dry coal at and from ι temperature of 212° F., 10.35 pounds; dry coal consumed per electrical horsepower per hour, 3.37 ›ounds. With washed coal, rocking grate, better of two tests; water evaporated, 9.65 pounds; coal :onsumed per electrical horsepower per hour, 3.37 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.24 pounds.

Coking test: Raw coal yielded good strong foundry coke, washed coal same, but of poorer appear-ınce. Washed coal burned 92 hours, gave 66.14 per cent coke containing 6.95 per cent ash and 0.81 per cent sulphur.

Washing test, crushed to 2 inches and washed in modified Stewart jig: Ash reduced, sulphur unchanged.

Pennsylvania, No. 6.—Operator, Hustead-Seamens Coal and Coke Company. Mine, Hustead-Seamens, at East Millsboro, Westmoreland County. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car samples.	
Proximate.	Moisture	4.08	2.81	3.24	3.46
	Volatile matter	32.44	33.88	31.78	31.80
	Fixed carbon	53.98	54.68	52.46	51.74
	Ash	9.50	8.63	12.52	13.00
Ultimate.	Sulphur	1.64	2.00	1.94	1.95
	Hydrogen	....	....	4.80	....
	Carbon	....	....	71.41	....
	Nitrogen	....	....	1.24	1.20
	Oxygen	....	....	8.09	....
Calorific value determined:					
	Calories	7,371	....	7,155	....
	British thermal units	13,268	....	12,879	....

Boiler tests: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 9.01 and 9.37 pounds; dry coal consumed per electrical horsepower per hour, 3.88 and 3,72 pounds.

Producer-gas tests: Dry coal consumed per electrical horsepower per hour, 1.48 and 1.19 pounds.

Coking tests: Raw coal, burned 46, 38, and 72 hours, made good, heavy coke with high ash and sulphur; yield of 72-hour coke, 72.86 per cent—coke contained 15.81 per cent ash and 1.52 per cent sulphur; washed coal burned 45 hours, gave 69.05 per cent coke, containing 10.49 per cent ash and 1.21 per cent sulphur. Not as good looking as coke from raw coal.

Pennsylvania, No. 7.—Operator, Old Colony Coal and Coke Company. Mine, Ligonier, 3 miles north of Ligonier, Westmoreland County. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	3.30	2.78	4.09
	Volatile matter	23.03	22.91	20.62
	Fixed carbon	62.49	61.58	62.82
	Ash	11.18	12.73	12.47
Ultimate.	Sulphur	1.79	1.88	2.08
	Hydrogen			4.73
	Carbon			72.78
	Nitrogen			1.50
	Oxygen			6.44
Calorific value determined:				
	Calories	7,432		7,307
	British thermal units	13,378		13,153

Boiler test, with raw coal: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 9.18 pounds; dry coal consumed per electrical horsepower per hour, 3.80 pounds. With washed coal, water evaporated 9.44 pounds; coal consumed, 3.70 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.62 pounds.

Coking test: Raw and washed coal gave heavy coke, high in ash and sulphur; washed coal burned 93 hours yielded 70 per cent coke, which contained 14.13 per cent ash and 1.42 per cent sulphur. Some improvement by washing coal.

Washing test: Crushed to 2 inches and washed in modified Stewart jig, ash reduced from 12.47 to 10.08 per cent and sulphur from 2.08 to 1.55 per cent.

Pennsylvania, No. 8.—Operator, Pennsylvania Coal and Coke Company. Mine, No. 3, at Ehrenfeld, Cambria County. Seam, "Miller." Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	3.49	3.09	3.51
	Volatile matter	16.12	16.66	16.82
	Fixed carbon	74.68	74.79	73.04
	Ash	5.71	5.46	6.63
Ultimate.	Sulphur	.95	1.18	.94
	Hydrogen			4.56
	Carbon			80.70
	Nitrogen			1.26
	Oxygen			5.91
Calorific value determined:				
	Calories	8,064		7,933
	British thermal units	14,515		14,279

Boiler tests with rocking grate, best of three tests: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 10.42 pounds; dry coal consumed per electrical horsepower per hour, 3.35 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.25 pounds.

Coking test: Crushed raw coal burned 51 hours gave 52.23 per cent of dull-gray, soft, dense coke with heavy black butts; coke contained 7.94 per cent ash and 0.91 per cent sulphur.

Pennsylvania, No. 9.—Operator, Reading Iron Company. Mine, Kimmelton, at Kimmelton, Somerset County. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	2.63	3.90	3.09
	Volatile matter	16.22	14.64	17.29
	Fixed carbon	70.94	73.13	68.29
	Ash	10.21	8.33	11.33
Ultimate.	Sulphur	2.05	1.76	2.04
	Hydrogen			4.19
	Carbon			75.40
	Nitrogen			1.25
	Oxygen			5.79
Calorific value determined:				
	Calories	7,614		7,458
	British thermal units	13,705		13,424

Coking test: Crushed raw coal yielded a few pieces of coke; same, with 5 per cent pitch, burned 38 hours, gave 66.25 per cent of poor soft coke; crushed washed coal gave a rather poor coke, dull gray in color, and which broke badly into small pieces. Breeze content large. Sulphur and ash reduced by washing.

Washing test: Crushed to 2 inches and washed in modified Stewart jig, ash reduced from 11.33 to 8.75 per cent, sulphur from 2.04 to 1.24 per cent.

Pennsylvania, No. 10.—Operator, Pittsburg-Buffalo Coal Company. Mine, Bertha, at Bruce, Allegheny County. Kind of coal, bituminous, "three-fourths inch."

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	3.67	4.08	2.61
	Volatile matter	34.03	34.41	34.92
	Fixed carbon	56.84	56.19	56.30
	Ash	5.46	5.32	6.17
Ultimate.	Sulphur	1.37	1.31	1.26
	Hydrogen			5.21
	Carbon			77.14
	Nitrogen			1.57
	Oxygen			8.65
Calorific value determined:				
	Calories	7,708		7,776
	British thermal units	13,874		13,997

Boiler test, with rocking grate, best of three tests: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 9.69 pounds; dry coal consumed per electrical horsepower per hour, 3.61 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.28 pounds.

Coking test: Crushed raw coal burned 47 hours yielded 69.35 per cent coke, containing 8.57 per cent ash and 1.05 per cent sulphur.

TENNESSEE.

Total production in 1905, 5,963,396 short tons; spot value, $6,797,550.

The year 1905 was one of unprecedented activity in the coal-mining industry of Tennessee, the production increasing from 4,782,211 short tons in 1904 to 5,963,396 tons in 1905, a gain of 1,181,185 short tons, or 24.7 per cent. The value increased somewhat less in proportion, from $5,642,393 to $6,797,550, a gain of $1,155,157, or 20.5 per cent. The average price per ton has declined from $1.25 in 1903 to $1.18 in 1904 and $1.14 in 1905.

With the gain in production the number of men employed increased from 10,416 in 1904 to 12,198 in 1905, while the average number of days worked increased from 217 to 222. The average production per man was 488.9 short tons in 1905, against 459.1 in 1904 and 482 in 1903. The average daily production per man was 2.2 tons in 1905 and 2.12 in both 1904 and 1903. Nearly 60 per cent of the coal mines of Tennessee, employing somewhat less than half of the total number of men, are operated on a 9-hour basis, there being 63 mines out of a total of 115, and employing 5,813 out of a total of 12,198, which reported a 9-hour day. Three mines with 243 men worked 9½ hours, and 30 mines, employing 4,220 men, worked 10 hours, while 8 mines, having a total of 1,026 men, worked 8 hours. The State convict mines at Petros, where 703 convicts were employed in 1905, worked 11 hours a day and 310 days in the year. Ten mines, in which 193 men were employed, did not report the number of hours worked.

Compared with the preceding year there was little disturbance by reason of strikes in 1905. There were only three mines at which suspensions from strikes occurred in 1905, and these made 150 men idle for an average of 32 days, while in 1904 2,391 men were idle for an average of 71 days. This comparative freedom from labor troubles in 1905 was partially responsible for the increased production.

The number of mining machines reported for Tennessee in 1905 was 89, against 85 in 1904 and 51 in 1903. The machine-mined production last year amounted to 479,-471 short tons, compared with 440,618 tons in 1904 and 304,602 tons in 1903. Of the machines in use in 1905, 77 were of the pick or puncher type, and 12 were chain machines.

According to Mr. J. W. Allen, statistician for the Commissioner of Labor, there were 29 fatal accidents in the coal mines of Tennessee in 1905. Thirteen wives were made widows and 30 children left fatherless. The death rate per thousand employees was 2.38, and the number of tons mined for each life lost was 205,634.

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 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.

Coal production of Tennessee in 1905, 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	831,100	5,998	8,680	....	845,778	$948,891	$1.12	219	1,501
Campbell	861,730	28,312	15,876	174,622	1,080,540	1,219,699	1.13	199	2,620
Claiborne	1,002,063	7,540	7,389	3,461	1,020,453	1,054,562	1.03	203	1,718
Grundy	559,883	5,925	1,080	....	566,888	594,223	1.05	236	747
Hamilton	196,323	8,508	5,197	86,417	296,445	354,730	1.20	202	637
Marion	306,816	5,802	8,860	95,290	416,768	533,355	1.28	235	838
Morgan	486,441	4,324	14,427	115,395	620,587	700,621	1.13	263	1,317
Overton	81,483	1,510	1,500	....	84,493	106,567	1.26	217	180
Scott	182,921	4,800	3,537	....	191,258	268,592	1.40	240	408
Other counties [a]	494,002	14,622	27,725	302,653	839,002	1,014,484	1.21	234	2,232
Small mines	....	1,184	....	....	1,184	1,826	1.54	....	....
Total	5,002,762	88,525	94,271	777,838	5,963,396	6,797,550	1.14	222	12,198

[a] Bledsoe, Cumberland, Fentress, Franklin, Rhea, Roane, Sequatchie, and White.

In the following table is presented a statement of the production of coal in Tennessee during the last 5 years, with the increases and decreases in 1905 as compared with 1904. It will be observed that the increased production in 1905 was well distributed among the coal-producing counties, all but two, and these were comparatively unimportant, showing increased tonnage.

Coal production of Tennessee, 1901–1905, by counties.

[Short tons.]

County.	1901.	1902.	1903.	1904.	1905.	Increase or decrease, 1905.
Anderson	664,409	759,276	655,721	630,109	845,778	+ 215,669
Campbell	570,343	654,165	700,368	804,750	1,080,540	+ 275,790
Claiborne	451,590	748,765	784,628	961,255	1,020,453	+ 59,198
Cumberland	55,327	109,582	134,093	91,718	35,052	− 56,666
Grundy	326,990	332,550	466,642	357,219	566,888	+ 209,669
Hamilton	242,993	250,526	264,268	252,735	296,445	+ 43,710
Marion	307,609	312,446	439,784	388,605	416,768	+ 28,163
Morgan	367,004	469,642	524,485	484,232	620,587	+ 136,355
Overton	....	....	83,340	106,403	84,493	− 21,910
Putnam	3,648	....	....	....	....	....
Rhea	183,005	239,697	231,689	204,992	240,590	+ 35,598
Roane	159,221	152,947	129,480	98,519	122,403	+ 23,884
Scott	102,654	98,529	142,424	123,478	191,258	+ 67,780
White	192,226	182,501	167,900	149,286	309,233	+ 159,947
Other counties and small mines	6,271	72,342	73,182	128,910	132,908	+ 3,998
Total	3,633,290	4,382,968	4,798,004	4,782,211	5,963,396	+ 1,181,185
Total value	$4,067,389	$5,399,721	$5,979,830	$5,642,393	$6,797,550	+$1,155,157

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, the Walden, and the 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 the product is highly esteemed as domestic fuel. These lower beds are developed chiefly at Bonair and in the vicinity of South Pittsburg.

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 annual production of the State since 1842 has been about as follows, the output for the years for which no statistics are available having been estimated by the writer:

Coal production of Tennessee, 1840–1905.

[Short tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1840 [a]	558	1862	140,000	1884	1,200,000
1841	600	1863	100,000	1885	1,440,957
1842	1,000	1864	100,000	1886	1,714,290
1843	4,500	1865	100,000	1887	1,900,000
1844	10,000	1866	100,000	1888	1,967,297
1845	18,000	1867	110,000	1889	1,925,689
1846	25,000	1868	125,000	1890	2,169,585
1847	30,000	1869	130,000	1891	2,413,678
1848	40,000	1870 [a]	133,418	1892	2,092,064
1849	52,000	1871	180,000	1893	1,902,258
1850	60,000	1872	224,000	1894	2,180,879
1851	70,000	1873	350,000	1895	2,535,644
1852	75,000	1874	350,000	1896	2,663,106
1853	85,000	1875	360,000	1897	2,888,849
1854	90,000	1876	550,000	1898	3,022,896
1855	100,000	1877	450,000	1899	3,330,659
1856	115,000	1878	375,000	1900	3,509,562
1857	125,000	1879	450,000	1901	3,633,290
1858	135,000	1880 [a]	495,131	1902	4,382,968
1859	150,000	1881	840,000	1903	4,798,004
1860 [a]	165,300	1882	850,000	1904	4,782,211
1861	150,000	1883	1,000,000	1905	5,963,396

[a] United States census, fiscal year.

TEXAS.

Total production in 1905, 1,200,684 short tons; spot value, $1,968,558.

Notwithstanding the large production of fuel oil in Texas during 1905, which resulted in a decreased production of coal in Arkansas and the Indian Territory, the output in Texas shows a slight increase from 1,195,944 short tons in 1904 to 1,200,684 short tons in 1905. The increased production in Texas, in the face of the decreased output in Arkansas and Indian Territory, may be attributed to the fact that the product of the former is consumed largely by the railroads on the lines of which the principal mines are located, and with the increased railway traffic, which was one of the industrial features of Texas, the output of these mines was augmented accordingly. It is to be noted, moreover, in the lignite-producing districts, with the output of which the fuel oil comes more directly into competition, that there was a decrease in 1905 of 30,096 tons as compared with 1904, this decrease in lignite production being somewhat more than made up by a gain of 34,836 tons in the bituminous-coal-producing counties. In the prices of both products, however, there was a decline, the average price per ton for bituminous coal at the mines dropping from $2.13 to $2.08, while lignite fell off from 78 cents to 73 cents. The total value for the State, in spite of the increased output, decreased from $1,983,636 in 1904 to $1,968,558.

There was employed in the coal and lignite mines of Texas in 1905 a total of 3,008 men, who made an average of 238 working days. Of this number of men 1,442, or nearly 48 per cent, worked 8 hours per day, and 1,240, or 40 per cent, worked 10 hours. One mine reported working less than 8 hours per day, and one worked 9 hours. Six mines, employing 256 men, did not report the number of hours per day. In 1904 there were 1,624 men that worked 8 hours and 971 that worked 10 hours, with 326 "scattering."

Comparing these statistics with those of the production, it is seen that in 1905 the average tonnage per man was 399.2 against 409.4 in 1904. The average daily production per man was 1.68 tons in 1905 against 1.86 in 1904.

There were only two mines in Texas in which mining machines were employed. The number of machines in use in 1905 was 8, and the machine-mined product amounted to 22,400 short tons, against 9 machines, which produced 33,154 tons in 1904. Of the machines in use in 1905, 5 were of the pick or puncher type and 3 were long-wall.

Only one strike was reported in 1905. This occurred at one of the lignite mines in Medina County and resulted in 25 men losing 15 days each—not enough to affect the totals for the year.

There were 12 counties that produced coal or lignite in 1905, a decrease of 1, compared with 1904. Bituminous coal was produced in 6 counties, and 6 counties produced lignite. The 6 bituminous-producing counties were Erath, Maverick, Palo Pinto, Parker, Webb, and Wise. No production was reported from Eastland County in 1905, although a small amount of bituminous coal was mined in that county in 1904. Hopkins County is credited with a small production of lignite in 1905, while Shelby County is dropped from the list.

In the following tables are presented the statistics of production in the last 2 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 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.
Bituminous:	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
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

Coal production of Texas in 1905, 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.
Bituminous:	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Erath Maverick Palo Pinto Parker Webb Wise	780,127	8,138	20,886	809,151	$1,684,527	$2.08	253	2,269
Lignite:								
Bastrop Hopkins Houston Madina Milam Wood	382,670	2,743	6,120	391,533	284,031	.73	194	739
Total	1,162,797	10,881	27,006	1,200,684	1,968,558	1.64	238	3,008

The coals of Texas occur 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 age extend entirely across the State from the eastern boundary at Sabine River in a southwesterly direction to the Rio Grande. In the southwestern extremity, near Laredo, in Webb County, the lignite approaches bituminous in character and the Webb County production is classed as bituminous. Lignite mining operations have been carried on in Anderson, Bastrop, Hopkins, 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.

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, 1884–1905.

[Short tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1884	125,000	1892	245,690	1900	968,373
1885	100,000	1893	302,206	1901	1,107,953
1886	100,000	1894	420,848	1902	901,912
1887	75,000	1895	484,959	1903	926,759
1888	90,000	1896	544,015	1904	1,195,944
1889	128,216	1897	639,341	1905	1,200,684
1890	184,440	1898	686,734		
1891	172,100	1899	883,832		

RESULTS OF TESTS OF TEXAS COALS.

The more important features of the results of tests made on Texas coals at the Geological Survey Coal Testing Plant[a] at St. Louis, Mo., are briefly summarized below. For more detailed reports see Professional Paper No. 48 and Bulletin No. 290 of the United States Geological Survey.

Texas, No. 1.—Operator, Houston County Coal and Manufacturing Company. Mine, Wootters, 11 miles south of Crockett, Houston County. Kind of coal, brown lignite, over ½-inch bar screen.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	32.58	33.50	34.70
	Volatile matter	37.02	39.50	32.23
	Fixed carbon	19.56	16.25	21.87
	Ash	10.84	10.75	11.20
Ultimate.	Sulphur	.56	.56	.79
	Hydrogen			6.93
	Carbon			39.25
	Nitrogen			.72
	Oxygen			41.11
Calorific value determined:				
	Calories		3,968	3,920
	British thermal units		7,142	7,056

Producer-gas test: Dry coal consumed per electrical horsepower per hour 2.22 pounds.

[a] For brief description of the equipment used in these tests see page 6.

Texas, No. 2.—Operator, Consumer Lignite Company. Mine, at Hoyt, Wood County. Kind of coal, brown lignite.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	28.86	31.34	33.71
	Volatile matter	35.96	41.18	29.25
	Fixed carbon	27.26	18.98	29.76
	Ash	7.92	8.50	7.28
Ultimate.	Sulphur	.50	.57	.53
	Hydrogen			6.79
	Carbon			42.52
	Nitrogen			.79
	Oxygen			42.09
Calorific value determined:				
	Calories	4,442		4,082
	British thermal units	7,996		7,348

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.71 pounds.

UTAH.

Total production in 1905, 1,332,372 short tons; spot value, $1,793,510.

Coal production in Utah, which was stimulated to a considerable extent by labor difficulties among the miners in Colorado in 1903, and to a less degree in 1904, felt the influence of the comparative peace which reigned in Colorado last year, and decreased from 1,681,409 short tons in 1903 to 1,493,027 short tons in 1904, and to 1,332,372 short tons in 1905. It would appear, moreover, that quite a number of mine workers who migrated into Utah from the Colorado fields during the strike returned to their old places, and that shortage of labor was in part responsible for the decreased production. This is indicated by the fact that values have been enhanced, the average price having advanced from $1.20 in 1903 to $1.30 in 1904, and to $1.35 in 1905. Consequently, while the production in 1905 was 160,655 short tons, or 10.8 per cent less than in 1904, and 349,037 tons, or 20.8 per cent less than in 1903, the percentage loss in value was 7.7 as compared with 1904 and 11.4 as compared with 1903.

The number of men employed in the coal mines of Utah in 1905 was 1,361, as compared with 1,374 in 1904 and 1,925 in 1903. The average working time in 1905 was 247 days, against 294 in 1904 and 248 in 1903. Taking these figures in connection with the tonnage for the three years, it is found that the average production per man for the entire year was 873 in 1903, 1,086.6 in 1904, and 979 in 1905, while the average tonnage per day per man was respectively 3.52, 3.7, and 3.96. As a matter of fact, in the average production per employee Utah stands near the head of the list, and in addition to this excellent showing the industry in the State was almost entirely free from strikes in each of the last two years, the one strike of 6 men for 1 day, in 1905, not being sufficient to be classed as such. Of the 1,361 men employed in 1905, 1,352 were reported as working 8 hours a day.

According to statistics compiled by Mr. Gomer Thomas, State coal-mine inspector, there were 43 accidents in the Utah coal mines in 1905, of which 7 resulted fatally. There were 3 wives made widows and 13 children were left fatherless. The death rate per thousand employees was 5.14, and the production for each life lost was 190,339 tons.

The statistics of production by counties in 1904 and 1905, with the distribution of the product for consumption, is shown in the following tables. It will be observed that in these tables it appears that there was a decrease of 102,196 short tons in the amount of coal made into coke in 1905 as compared with the preceding year. This decrease is apparent only, for in addition to the 247,585 short tons of coal coked at the mines, as shown in the table, there were 159,758 tons shipped from Sunnyside to Castle Gate and made into coke at the latter place. This factor is reported under shipments, not having been made into coke at the mines.

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

Coal production of Utah in 1905, 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	958,999	6,249	45,513	247,585	1,258,346	$1,674,742	$1.33	251	1,216
Emery		3,692			3,692	5,084	1.38	68	11
Morgan, Sanpete	2,632	3,484	20		6,136	11,735	1.91	132	28
Summit, Uinta	50,283	6,865	4,818		61,966	97,385	1.57	249	106
Small mines		2,232			2,232	4,564			
Total	1,011,914	22,522	50,351	247,585	1,332,372	1,793,510	1.35	247	1,361

The production, by counties, during the last 5 years, and the increases and decreases in 1905 as compared with 1904, are shown in the following table:

Coal production of Utah, 1901–1905, by counties.

[Short tons.]

County.	1901.	1902.	1903.	1904.	1905.	Increase or decrease, 1905.
Carbon	1,259,247	1,507,689	1,599,986	1,416,623	1,258,346	− 158,277
Emery	1,374	4,718	8,178	4,031	3,692	− 339
Iron		520				
Morgan, Sanpete	3,030	8,531	7,296	7,733	6,136	− 1,597
Summit, Uinta	58,963	53,063	64,054	61,320	61,966	+ 646
Small mines			1,895	3,320	2,232	− 1,088
Total	1,322,614	1,574,521	1,681,409	1,493,027	1,332,372	− 160,655
Total value	$1,666,082	$1,797,454	$2,026,038	$1,943,440	$1,793,510	−$149,930

Like the other coal-producing States of the Rocky Mountain region, the coal areas of Utah are widely distributed. The largest field and the most important in respect to the thickness and development of the coals as far as known is that of the Book Cliffs, known formerly as the Wasatch field. This field is situated in the Book Cliffs, from the Colorado line westward to Castle Gate, near the center of the State, and thence southwestward in the eastern escarpment of the Wasatch Plateau to eastern Sevier County. Its length in the State is about 160 miles. Only the western half has been surveyed, and estimating from this known part the total area will approximate about 1,600 square miles.

Next in importance as regards known occurrence and development of coal is the Coalville or Weber River field, situated in Summit County, off the eastern flank of the Wasatch Mountains. This field has an area of a few square miles of available coal. The chief difficulties in the way of extensive development of the Coalville coals are in the nature of protracted faulting and tilting of the strata including the coal beds. Other known coal areas are Henry's Fork and Ashley Creek, in the northeastern part of the State; Colob Plateau, in the southwestern part of the State, and the Henry Mountains district. Workable coal beds are reported to occur at a number of places in the northern part of the Uintah Reservation and in Uinta County, but little is known of the extent and quality of the coals in these areas. The mining that has been done was for local use. According to reports coming from the Colob and Uintah fields, it is possible that their areas combined may equal that of the Book Cliffs field.

All of the really large mining properties are in the western part of the Book Cliffs field at Sunnyside, Castle Gate, Winterquarters, and Clear Creek, in Carbon County, which produces 95 per cent of the coal output of the State. These coals with that at Coalville are of fair grade, bituminous in class, and of Cretaceous age. Some of them make a good quality of coke, from 350,000 to 400,000 tons of the total coal product being so consumed in each year.

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, 1870–1905.

[Short tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1870	5,800	1886	200,000	1897	521,560
1876	50,400	1887	180,021	1898	593,709
1877	50,400	1888	258,961	1899	786,049
1878	67,200	1889	236,651	1900	1,147,027
1879	50,000	1890	318,159	1901	1,322,614
1880	14,748	1891	371,045	1902	1,574,521
1881	52,000	1892	361,013	1903	1,681,409
1882	100,000	1893	413,205	1904	1,493,027
1883	200,000	1894	431,550	1905	1,332,372
1884	200,000	1895	471,836		
1885	213,120	1896	418,627		

VIRGINIA.

Total production in 1905, 4,275,271 short tons; spot value, $3,777,325.

The coal-mining industry of Virginia has grown with great rapidity during the last 15 years, the production having increased each year since 1896, and, with one exception, since 1892. The output in 1905, therefore, was the largest in the history of the State. Compared with the preceding year, the production in 1905 showed an increase of 864,357 short tons, or 25.3 per cent, in quantity, and of $855,414, or 29.3 per cent, in value. The principal gain was in Wise County, where the production increased from 2,359,661 short tons to 2,990,698 short tons, though the other counties also showed increased production, particularly Tazewell County. Tazewell and Wise counties also exhibited an advance in prices and the average for the State showed a gain from 86 cents to 88 cents per ton.

The number of men employed increased from 5,165 in 1904 to 5,730 in 1905, while the average working time increased from 238 days to 241 days, most of which were 10 hours long. Of the total number of men employed, 3,999 worked 10 hours, 591 worked 9 hours, and 522 worked 8 hours. One mine employing 400 men reported 7 hours as the length of the working day, and 4 mines did not report.

The average production per man in 1905 was 746.1 short tons against 660.4 tons in 1904 and 615 tons in 1903. The average daily production per man was 3.10 in 1905, 2.77 in 1904, and 2.3 short tons in 1903.

No strikes were reported in 1904 nor in 1905.

In the following tables are presented the statistics of production, by counties, in 1904 and 1905, with the distribution of the product for consumption:

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	883,286	25,466	46,086	1,404,823	2,359,661	1,910,275	.81	243	3,464
Chesterfield, Pulaski, Russell	154,922	1,026	1,657	....	157,605	132,046	.84	184	381
Small mines	....	300	....	....	300	550	......	....	....
Total	1,729,840	40,985	63,085	1,577,004	3,410,914	2,921,911	.86	238	5,165

[a] Seemingly large number of men employed due to extensive development work.

Coal production of Virginia in 1905, 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.*				
Tazewell	748,371	10,677	17,166	185,166	961,380	$902,335	$0.94	231	1,375
Wise	957,385	36,411	63,404	1,933,498	2,990,698	2,525,635	.84	247	3,700
Other counties[a] and small mines	304,332	11,998	6,863	....	323,193	349,355	1.08	226	655
Total	2,010,088	59,086	87,433	2,118,664	4,275,271	3,777,325	.88	241	5,730

[a] Lee, Montgomery, Pulaski, and Russell.

The statistics of production, by counties, during the last five years, with the increases and decreases in 1905 as compared with 1904, are shown in the following table:

Coal production of Virginia, 1901–1905, by counties.

[Short tons.]

County.	1901.	1902.	1903.	1904.	1905.	Increase or decrease, 1905.
Montgomery	11,177	12,786	20,288	....	....	....
Tazewell	776,568	723,753	840,195	871,720	961,380	+ 89,660
Wise	1,918,693	2,422,417	2,563,285	2,359,661	2,990,698	+ 631,037
Chesterfield, Henrico	11,760	16,206	13,084	2,100	....	− 2,100
Pulaski, Russell	7,675	7,831	9,255	[a] 177,133	[b] 323,073	+ 145,940
Small mines	....	....	200	300	120	− 180
Total	2,725,873	3,182,993	3,451,307	3,410,914	4,275,271	+ 864,357
Total value	$2,353,989	$2,543,595	$3,302,149	$2,921,911	$3,777,325	+$855,414

[a] Includes Montgomery County. [b] Includes Lee and Montgomery counties.

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 and 1905 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. Recently the Elkhorn district of Kentucky has been opened up by a branch of the Chesapeake and Ohio Railroad and a new road is being graded from the Breaks of Sandy southeastward toward the seaboard along the line of the old "3 C's." This will, if built, open valuable territory on the headwaters of Russell Fork of Sandy River.

As has been stated, 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 antidates by 19 years the first reliable record of the use of anthracite in Pennsylvania, but, unfortunately, Mr. Nicolls 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 4,200,000 short tons in 1905, as shown in the table following:

Coal production of Virginia, 1822–1905.

[Short tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1822	54,000	1850	310,000	1878	50,000
1823	60,000	1851	310,000	1879	45,000
1824	67,040	1852	325,000	1880 [a]	43,079
1825	75,000	1853	350,000	1881	50,000
1826	88,720	1854	370,000	1882	112,000
1827	94,000	1855	380,782	1883	252,000
1828	100,080	1856	352,687	1884	336,000
1829	100,000	1857	363,605	1885	567,000
1830	102,800	1858	377,690	1886	684,951
1831	118,000	1859	359,055	1887	825,263
1832	132,000	1860 [a]	473,660	1888	1,073,000
1833	125,000	1861	445,165	1889	865,786
1834	124,000	1862	445,124	1890	784,011
1835	120,000	1863	40,000	1891	736,399
1836	134,000	1864	40,000	1892	675,205
1837	160,000	1865	40,000	1893	820,339
1838	300,000	1866	40,000	1894	1,299,083
1839	396,000	1867	50,000	1895	1,368,324
1840 [a]	424,894	1868	59,051	1896	1,254,723
1841	379,600	1869	65,000	1897	1,528,302
1842	373,640	1870 [a]	61,803	1898	1,815,274
1843	370,000	1871	70,000	1899	2,105,791
1844	365,000	1872	69,440	1900	2,393,754
1845	350,000	1873	67,200	1901	2,725,873
1846	340,000	1874	70,000	1902	3,182,993
1847	325,000	1875	60,000	1903	3,451,307
1848	318,000	1876	55,000	1904	3,583,914
1849	315,000	1877	50,000	1905	4,270,760

[a] United States census, fiscal year.

RESULTS OF TESTS OF VIRGINIA COALS.

The more important features of the results of tests made on Virginia coals at the Geological Survey coal-testing plant[a] at St. Louis, Mo., are briefly summarized below. For more detailed reports see Professional Paper No. 48 and Bulletin No. 290 of the United States Geological Survey.

Virginia, No. 1.—Operator, Interstate Investment Company. Mine, H. C. Morris prospect, at Crab Orchard, Lee County. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.			Car sample.
Proximate.	Moisture	4.72	5.69	6.55	4.06
	Volatile matter	34.21	34.43	33.51	34.93
	Fixed carbon	56.44	51.77	55.54	56.28
Proximate / Ultimate.	Ash	4.63	8.11	4.40	4.73
Ultimate.	Sulphur	2.55	2.31	.80	1.20
	Hydrogen				5.32
	Carbon				76.59
	Nitrogen				1.24
	Oxygen				10.92
Calorific value determined:					
	Calories		7,287		7,681
	British thermal units		13,117		13,826

Boiler test with rocking grate, better of two trials: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 10.01 pounds; dry coal consumed per electrical horsepower per hour, 3.49 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.44 pounds.

Coking test: Crushed and uncrushed raw coal made good, heavy, silvery coke, and crushed coal made less breeze. One charge of latter burned 36 hours yielded 68.11 per cent coke, containing 7.86 per cent ash and 0.94 per cent sulphur, with only 2.58 per cent breeze.

Virginia, No. 2.—Operator, Interstate Investment Company. Mine, opening on Wilson farm, near Crab Orchard, Lee County. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	3.90	6.80	3.35
	Volatile matter	34.08	33.01	35.13
	Fixed carbon	56.96	58.26	55.94
Proximate / Ultimate.	Ash	5.06	1.93	5.58
Ultimate.	Sulphur	.90	.68	.92
	Hydrogen			5.19
	Carbon			77.02
	Nitrogen			1.42
	Oxygen			9.87
Calorific value determined:				
	Calories			7,740
	British thermal units			13,932

Boiler tests: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 10.02 and 9.65 pounds; dry coal consumed per electrical horsepower per hour, 3.48 and 3.62 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.35 pounds.

Coking test: Crushed raw coal burned 51 hours gave 62.65 per cent good foundry coke, containing 7.42 per cent ash and 0.58 per cent sulphur.

Washing test: Washing coal crushed to 2 inches in modified Stewart jig did not reduce impurities in coke enough to warrant expense.

[a] For brief description of the equipment used in these tests see page ——.

Virginia, No. 3.—Operator, Virginia Iron, Coal, and Coke Company. Mine, Coburn, at Toms Creek, Wise County. Kind of coal, bituminous, over 3½-inch bar screen.

Chemical analyses.

		Mine samples.		Car sample.
Proximate	Moisture	2.70	2.91	3.05
	Volatile matter	32.45	31.99	31.65
	Fixed carbon	60.36	60.97	60.82
	Ash	4.49	4.13	4.48
Ultimate.	Sulphur	.52	.55	.67
	Hydrogen			5.17
	Carbon			80.35
	Nitrogen			1.59
	Oxygen			7.74
Caloric value determined:				
	Calories			8,039
	British thermal units			14,470

Boiler test, rocking grate: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 10.66 and 10.84 pounds; dry coal consumed per electrical horsepower per hour, 3.52 and 3.45 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.19 pounds.

Coking test: Crushed raw coal burned 45 hours made 68.0 per cent fine heavy coke, containing 5.90 per cent ash and 0.61 per cent sulphur.

Virginia, No. 4.—Operator, Darby Coal and Coke Company. Mine, Darby, at Darby, Lee County. Kind of coal, bituminous, over 1¼-inch bar screen.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	3.89	3.55	4.35
	Volatile matter	34.89	37.06	36.89
	Fixed carbon	58.16	56.88	54.43
	Ash	3.06	2.51	4.33
Ultimate.	Sulphur	.34	.50	.79
	Hydrogen			5.25
	Carbon			76.99
	Nitrogen			1.32
	Oxygen			11.32
Calorific value determined:				
	Calories	7,858		7,744
	British thermal units	14,144		13,939

Boiler test, best of three: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 10.18 pounds. Dry coal consumed per electrical horsepower per hour, 3.43 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.27 pounds.

Coking test: Crushed raw coal burned 36 hours gave 62.72 per cent fine-fingered light weight coke.

WASHINGTON.

Total production in 1905, 2,864,926 short tons; spot value, $5,141,258.

The coal production of Washington has decreased in each of the last two years from 3,193,273 short tons in 1903 to 3,137,681 short tons in 1904 and to 2,864,926 short tons in 1905. Compared with the output in 1904 that of 1905 shows a decrease of 272,755 short tons, or 8.7 per cent. The production in 1904 was 55,592 short tons, or 1.7 per cent less than that of 1903. The decreased production of Washington coal is ascribed to the greatly increased production and use of fuel oil in California, and this would appear to be borne out by the statistics of production in 1904 compared with the preceding year, for with the smaller output in 1904 there was a decline in price, and the total value fell off 4.8 per cent, as compared with a loss of 1.7 per cent in quantity. In 1905, however, there was a marked advance in prices in all three of the principal producing counties, and the total average for the State shows an advance of 16 cents per ton, from $1.63 in 1904 to $1.79 in 1905, and notwithstanding the decrease in production of 272,755 short tons the value exhibits a gain of $20,327. The only explanation for this appears to be that the coal exported from Washington to California points has to be sold at lower prices than that marketed locally.

The number of men employed in the coal mines of Washington in 1905 was 4,765, who worked an average of 227 days, against 5,287 men for 243 days in 1904. The average production per man, therefore, was 601.2 tons for 1905 against 593.5 tons in 1904. The average daily production per man was 2.65 tons in 1905 and 2.44 in 1904. Most of the mines in Washington are operated 8 hours a day, at least for the miners, though in a number of cases where the miners work 8 hours the "day" men put in 9½ or 10 hours. In 1905 there were 18 mines employing a total of 3,644 men, in which the miners worked 8 hours; 1 mine, employing 28 men, worked 9 hours, and 8 mines, with a total of 353 men, worked 10 hours. Six mines, in which employment was given to 740 men, reported the number of hours per day as from 8 to 9 or 10. Coal mining in Washington was entirely free from strikes during 1905.

Mr. D. C. Botting, State inspector of coal mines, reports that in 1905 there were 103 accidents, as a result of which 13 men were killed and 90 injured. Seven of the men killed were married and 17 children were left fatherless. The death rate per thousand employees was 2.73. The number of tons mined for each life lost was 220,379.

No machines have been reported as in use in the coal mines of Washington since 1901.

The statistics of production in 1904 and 1905, with the distribution of the product for consumption, are shown in the following tables:

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.

Coal production of Washington in 1905, 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	1,026,958	24,429	47,776	....	1,099,163	$1,810,773	$1.65	252	1,671
Kittitas	1,242,943	9,692	28,210	....	1,280,845	2,284,263	1.78	195	2,250
Pierce	361,644	2,960	26,692	88,616	479,912	1,036,411	2.16	266	827
Other counties [a]	2,804	930	1,272	....	5,006	9,811	1.96	174	17
Total	2,634,349	38,011	103,950	88,616	2,864,926	5,141,258	1.79	227	4,765

[a] Cowlitz, Lewis, and Whatcom.

The total production of the State, by counties, during the last five years, with the increases and decreases in 1905 as compared with the preceding year, is shown in the following table:

Production of coal in Washingtan, 1901–1905, by counties.

[Short tons.]

County.	1901.	1902.	1903.	1904.	1905.	Increase or decrease, 1905.
Cowlitz	....	....	....	1,800	2,565	+ 765
King	957,549	1,017,888	1,229,560	1,219,230	1,099,163	−120,067
Kittitas	1,012,521	1,250,920	1,369,716	1,340,400	1,280,845	− 59,555
Lewis	520	826	1,410	1,335	1,300	− 35
Pierce	585,984	383,603	572,800	531,589	479,912	− 51,677
Skagit	12,643	21,967	19,115	10,650	....	− 10,650
Whatcom	9,000	6,010	672	1,837	1,141	− 696
Other counties	....	....	....	30,840	....	− 30,840
Total	2,578,217	2,681,214	3,193,273	3,137,681	2,864,926	−272,755
Total value	$4,271,076	$4,572,295	$5,380,679	$5,120,931	$5,141,258	+$20,327

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 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 and anthracite have been observed. The bituminous coking coals of Washington are the only 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, but at present coke is made only in the first-named district. The Wilkeson-Carbonado coal runs high in ash, and is usually washed before coking. The lignite or subbituminous coals of Newcastle and Renton, in the South Puget Sound field, are generally of high grade and well suited for domestic use. The steamship consumption in trade with Alaska and the Orient is now the most important market for the high-grade bituminous coals of Washington.

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, on account 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 13 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.

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, 1860–1905.

[Short tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1860 [a]	5,374	1876	110,342	1892	1,213,427
1861	6,000	1877	120,896	1893	1,264,877
1862	7,000	1878	131,660	1894	1,106,470
1863	8,000	1879	142,666	1895	1,191,410
1864	10,000	1880	145,015	1896	1,195,504
1865	12,000	1881	196,000	1897	1,434,112
1866	13,000	1882	177,340	1898	1,884,571
1867	14,500	1883	244,990	1899	2,029,881
1868	15,000	1884	166,936	1900	2,474,093
1869	16,200	1885	380,250	1901	2,578,217
1870 [a]	17,844	1886	423,525	1902	2,681,214
1871	20,000	1887	772,601	1903	3,193,273
1872	23,000	1888	1,215,750	1904	3,137,681
1873	26,000	1889	1,030,578	1905	2,864,926
1874	30,352	1890	1,263,689		
1875	99,568	1891	1,056,249		

[a] United States census, fiscal year.

WEST VIRGINIA.

Total production in 1905, 37,791,580 short tons; spot value, $32,341,790.

Since West Virginia first passed Ohio and became, in 1896, the third State in coal-producing importance it has been steadily gaining on Illinois, and with an increased production of 5,384,828 short tons, 16.6 per cent, in 1905, against an increase of only 1,959,303 short tons in the output of Illinois, West Virginia came within 642,783 short tons of displacing Illinois as the second in rank among the coal-producing States. The statistics of Illinois's production as compiled by the Survey show that the output in that State in 1905 was 38,434,363 short tons, against 36,475,060 short tons in 1904 and 36,957,104 in 1903, indicating that there has been comparatively little change during the last three years. West Virginia's production, on the other hand, has increased from 29,337,241 short tons in 1903 to 32,406,752 short tons in 1904 and to 37,791,580 short tons in 1905. It is highly probable that the report for 1906 will show that West Virginia has taken second place, from the fact that nearly all of the mines of Illinois were shut down for about two months pending the conclusion of an agreement with the miners' union, whereas those of West Virginia were more than usually active as a result of the extra demand put upon them by the suspension of work, not only in Illinois, but also in Indiana and Ohio.

As was the case generally throughout the coal-producing States east of the Mississippi River, the value of the product of West Virginia did not show a rate of increase proportionate to the increase in production. The average price per ton declined from 88 cents in 1904 to 86 cents in 1905. The total value increased from $28,647,014 to $32,341,790, a gain of $3,694,776, or 12.9 per cent, as compared with an increase of 16.6 per cent in production.

The total number of men employed in the coal mines of West Virginia in 1905 was 48,389, who worked an average of 209 days, against 47,235 men, for 197 days in 1904, and 41,554 men for 210 days in 1903. The average production for each employee in 1905 was 781, against 686.1 in 1904 and 706 in 1903. The average daily tonnage per man in the three years was 3.74 in 1905, 3.48 in 1904, and 3.36 in 1903. This increased tonnage per employee is undoubtedly due in large part to the increased use of machines for undercutting coal, as is shown by the fact that in 1903 there were 788 machines used in the production of 8,193,840 short tons of coal; in 1904, 901 machines were reported with a machine-mined production of 9,526,749 tons, and in 1905, 12,504,301 tons were mined with 1,105 machines.

Nearly all of the coal mines of West Virginia work either 9 or 10 hours per day. In 1905, out of a total of 513 mines, 251, employing 25,731 men, reported 10 hours as the length of the working day; 159, with 14,292 men, worked 9 hours; and 49, with 3,532 men, worked 8 hours. Five mines, employing 207 men, reported 8 to 9 or 8 to 10 hours, and 9 mines, with 1,464 men, worked less than 8 hours, while 40 mines did not report the number of hours per day.

Strikes in 1905 were of rare occurrence, and with one exception the suspensions from this cause were not of long duration. The one exception was at the Whittaker mine, of the Whittaker-Glessner Company, in Ohio County, where 15 men were on strike for 240 days. Altogether there were only 12 mines at which strikes occurred, and a total of 462 men were idle during an average of 26 days. The entire time lost by strikes was less than 0.12 per cent of the total time worked.

According to the report of Mr. James W. Paul, chief inspector of mines, for the fiscal year ended June 30, 1905, there were killed during that year a total of 194 men, while 250 were injured. The most serious accident occurred on March 18 and 19, 1905, at the Red Ash and Rush Run mines, in Fayette County, where explosions of dust resulted in the death of 24 men. Next to this was an explosion of powder and dust at the Grapevine shaft, in McDowell County, on February 26, 1905, when 7 men were killed. The only other accident which resulted in the death of more than one or two men was a powder explosion at the Cabin Creek mines, in Kanawha County. Six men were killed by this explosion. As a result of all the accidents which occurred during the fiscal year 83 wives were made widows and 169 children were left fatherless. The production for the fiscal year, as reported by Mr. Paul, was 35,283,392 short tons, and the number of employees, exclusive of coke workers, was 45,578. From this it appears that the death rate per thousand was 4.24, and that for each life lost there were mined 181,873 tons of coal.

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 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	148,059	2,471	11,135	....	161,665	151,971	.94	228	237
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	1,428,871	22,657	14,587	295,150	1,761,265	1,563,334	.89	203	1,886
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	72,556	44,609	1,560	....	118,725	115,928	.98	222	169
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	27,886,512	607,290	419,182	3,493,768	32,406,752	28,647,014	.88	197	47,235

[a] Braxton, Gilmer, Lincoln, Logan, and Ritchie.

Coal production of West Virginia in 1905, 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	580,566	6,820	11,000	17,051	615,437	$447,548	$0.73	212	782
Brooke	228,226	10,940	230	....	239,396	219,593	.92	246	474
Clay	76,199	3,490	735	....	80,424	81,606	1.01	174	73
Fayette	6,767,081	93,191	132,680	992,375	7,985,327	7,341,575	.92	203	11,390
Grant	194,706	2,740	10,480	....	207,926	188,955	.91	258	205
Hancock	51,000	5,780	903	....	57,683	76,135	1.32	208	120
Harrison	2,802,559	16,862	30,137	1,120	2,850,678	2,231,496	.78	201	2,927
Kanawha	3,816,693	52,172	46,391	58,461	3,973,717	3,349,902	.84	185	6,289
Logan	212,369	4,450	6,500	....	223,319	217,329	.97	240	311
McDowell	5,484,764	66,506	81,200	2,612,697	8,245,167	6,883,006	.83	214	9,456
Marion	3,288,962	18,062	49,242	264,953	3,621,219	2,862,235	.79	220	3,498
Marshall	362,279	71,032	5,462	....	438,773	408,015	.93	233	528
Mason	39,432	55,820	534	....	95,786	106,358	1.11	170	310
Mercer	1,634,265	17,233	48,882	568,696	2,269,076	1,938,849	.86	238	2,410
Mineral	566,278	8,522	494	....	575,294	529,041	.92	225	714
Mingo	1,562,857	96,507	20,162	....	1,679,526	1,304,352	.78	215	2,461
Monongalia	119,284	5,514	6,181	87,381	218,360	173,765	.80	199	337
Nicholas	54,109	3,680	390	....	58,179	51,937	.89	164	192
Ohio	80,483	27,538	1,180	....	109,201	103,331	.95	200	157
Preston	619,827	15,776	23,136	178,927	837,666	681,509	.81	224	1,408
Putnam	531,125	15,067	2,575	....	548,767	558,736	1.02	240	924
Raleigh	792,440	22,500	12,928	....	827,868	786,783	.95	193	1,390
Randolph	243,607	5,001	6,270	262,200	517,078	460,556	.89	215	508
Taylor	339,325	6,671	2,109	....	348,105	222,593	.64	176	424
Tucker	673,793	15,360	24,616	381,290	1,095,059	1,050,937	.96	247	1,028
Other counties[a] and small mines	37,235	35,214	100	....	72,549	65,648	.90	232	73
Total	31,159,464	682,448	524,517	5,425,151	37,791,580	32,341,790	.86	209	48,389

[a] Gilmer, Lincoln, Logan, Ritchie, Upshur, and Wayne.

The production during the last five years, by counties, with the increases and decreases in 1905 as compared with 1904, is shown in the following table:

Coal production of West Virginia, by counties, 1901–1905.

[Short tons.]

County.	1901.	1902.	1903.	1904.	1905.	Increase or decrease, 1905.
Barbour	313,376	512,725	742,928	666,019	615,437	− 50,582
Brooke	73,198	40,372	35,025	67,706	239,396	+ 171,690
Clay			22,094	55,814	80,424	+ 24,610
Fayette	6,052,389	4,775,112	6,092,193	7,222,247	7,985,327	+ 763,080
Grant		2,776	78,932	161,665	207,926	+ 46,261
Hancock		80,400	153,763	79,528	57,683	− 21,845
Harrison	1,762,563	2,066,597	2,504,638	2,714,832	2,850,678	+ 135,846
Kanawha	1,983,903	1,848,617	3,034,912	3,134,256	3,973,717	+ 839,461
Lewis		540				
Logan				326	223,319	+ 222,993
McDowell	4,995,511	5,459,655	6,103,800	6,755,138	8,245,167	+ 1,490,029
Marion	3,411,597	3,397,194	3,133,699	3,407,469	3,621,219	+ 213,750
Marshall	217,237	243,791	372,897	398,594	438,773	+ 40,179
Mason	129,964	144,727	127,646	117,437	95,786	− 21,651
Mercer	964,028	1,248,279	1,375,780	1,761,265	2,269,076	+ 507,811
Mineral	597,776	514,993	529,099	569,649	575,294	+ 5,645
Mingo	576,886	806,174	1,164,554	1,469,710	1,679,526	+ 209,816
Monongalia	110,801	153,474	161,912	200,567	218,360	+ 17,793
Nicholas			21,050	38,452	58,179	+ 19,727
Ohio	191,761	230,241	147,232	118,725	109,201	− 9,524
Preston	489,239	590,436	805,060	665,626	837,666	+ 172,040
Putnam	242,789	184,259	298,499	386,840	548,767	+ 161,927
Raleigh	148,493	281,817	417,459	591,794	827,868	+ 236,074
Randolph	161,561	400,145	458,401	379,622	517,078	+ 137,456
Taylor	380,590	368,650	292,146	283,332	348,105	+ 64,773
Tucker	1,097,340	1,166,080	1,241,565	1,126,883	1,095,059	− 31,824
Other counties and small mines	167,400	53,772	21,957	33,256	72,549	+ 39,293
Total	24,068,402	24,570,826	29,337,241	32,406,752	37,791,580	+ 5,384,828
Total value	$20,848,184	$24,748,658	$34,297,019	$28,647,014	$32,341,790	+$3,694,776

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, the Kanawha and Michigan Railway, which pass 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 railroads, so the two areas are considered as one district in this report.

Coal production of the principal districts of West Virginia, 1886–1905.

[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	3,503,260	1,141,430	942,154
1893	4,099,112	3,815,280	1,255,956	1,129,397
1894	3,650,971	5,059,025	1,655,532	927,220
1895	4,399,623	4,044,998	1,550,256	1,125,601
1896	4,650,455	4,608,113	1,743,590	1,245,012
1897	4,921,701	4,859,373	2,074,663	1,425,026
1898	5,947,272	5,521,160	2,525,294	1,531,562
1899	6,544,956	6,033,344	3,374,183	1,786,009
1900	7,804,879	6,901,637	4,187,630	1,999,797
1901	8,427,574	6,736,107	5,174,160	1,856,677
1902	7,089,805	7,431,687	5,463,791	2,581,218
1903	9,843,063	8,319,775	5,638,337	2,229,065
1904	11,429,403	10,858,159	7,937,845	1,858,197
1905	13,474,282	13,378,468	8,491,465	1,878,279

[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 1,400,000 tons.

Annual increase in the coal production of West Virginia, 1881–1905.

[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	3,069,511
1891 over 1890	1,826,011	1905 over 1904	5,384,828
1892 over 1891	518,090	Total increase in 25 years	36,111,580
1893 over 1892	969,823	Average annual increase	1,444,463
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		

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 five principal mining districts, and nearly all of the other 10 per cent comes from three 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 seldem 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 geological 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.

From the building of new railway lines and the extension by various branches of the old transportation systems which have been in progress during the last year, there is every reason to believe that the next few years will record a growth of the coal-mining industry of the State even greater than that exhibited during the past. The most important influence to be expected is that which will follow the completion of the Deepwater-Tidewater Railway, from Norfolk to the coal fields of the southern portion of West Virginia. This road will penetrate areas containing the Pocahontas, New River, and Kanawha coals, most of them in their highest development. The Coal and Coke Railroad, from Elkins to Charleston, with its branches, is opening up important fields in the center of the State, as is also the Kanawha and West Virginia Railroad. Other promising fields are being developed by branch lines of the Chesapeake and Ohio Railway, on Piney Creek and the Coal and Guyandotte rivers.

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, 1863–1905.

[Short tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1863	444,648	1878	1,120,000	1893	10,708,578
1864	454,888	1879	1,400,000	1894	11,627,757
1865	487,897	1880 [a]	1,829,844	1895	11,387,961
1866	512,068	1881	1,680,000	1896	12,876,296
1867	589,360	1882	2,240,000	1897	14,248,159
1868	609,227	1883	2,335,833	1898	16,700,999
1869	603,148	1884	3,360,000	1899	19,252,995
1870	608,878	1885	3,369,062	1900	22,647,207
1871	618,830	1886	4,005,796	1901	24,068,402
1872	700,000	1887	4,881,620	1902	24,570,826
1873	1,000,000	1888	5,498,800	1903	29,337,241
1874	1,120,000	1889	6,231,880	1904	32,406,752
1875	1,120,000	1890	7,394,654	1905	37,791,580
1876	896,000	1891	9,220,665		
1877	1,120,000	1892	9,738,755		

[a] United States census, fiscal year.

RESULTS OF TESTS OF WEST VIRGINIA COALS.

The more important features of the results of tests made on West Virginia coals at the Geological Survey coal-testing plant[a] at St. Louis, Mo., are briefly summarized below. For more detailed reports see Professional Paper No. 48 and Bulletin No. 290 of the United States Geological Survey.

[a] For brief description of the equipment used in these tests, see page 6.

West Virginia, No. 1.—Operator, West Virginia and Pittsburg Coal and Coke Company. Mine, Kingmont, at Kingmont, Marion County. Seam, Pittsburg. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	1.40	1.35	1.75
	Volatile matter	36.65	37.35	36.77
	Fixed carbon	55.28	54.88	55.14
	Ash	6.67	6.42	6.34
Ultimate.	Sulphur	1.59	1.31	.90
	Hydrogen	....	....	5.28
	Carbon	....	....	78.00
	Nitrogen	....	....	1.54
	Oxygen	....	....	7.94
Calorific value determined:				
	Calories	7,813	....	7,837
	British thermal units	14,063	....	14,107

Boiler test: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 8.95 pounds; dry coal consumed per electrical horsepower per hour, 3.90 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.57 pounds.

Coking test: Unwashed coal yielded coke of good quality, but somewhat brittle.

West Virginia, No. 2.—Operator, Pitcairn Coal Company. Mine, Pitcairn, at Clarksburg, Harrison County. Seam, Pittsburg. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	1.98	1.87	1.95
	Volatile matter	40.54	40.30	39.94
	Fixed carbon	48.40	49.73	50.25
	Ash	9.08	8.10	7.86
Ultimate.	Sulphur	4.20	3.75	3.48
	Hydrogen	....	....	5.13
	Carbon	....	....	74.07
	Nitrogen	....	....	1.36
	Oxygen	....	....	8.10
Calorific value determined:				
	Calories	7,481	....	7,661
	British thermal units	13,466	....	13,790

Boiler test: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 9.14 pounds; dry coal consumed per electrical horsepower per hour, 3.82 pounds.

Coking test: Washed and unwashed coal yield coke. Coke from unwashed coal gray, somewhat brittle, and high in ash and sulphur; coke from washed coal too high in ash for blast-furnace use.

Washing test: Washing coal improved coke; ash content of coal reduced from 8.22 to 7.05 per cent, and sulphur content from 3.38 to 2.84 per cent.

West Virginia, No. 3.—Operator, West Virginia Coal Company. Mine, Richard, 4 miles southeast of Morgantown, Monongalia County. Seam, Upper Freeport. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	2.90	2.21	2.29
Proximate.	Volatile matter	28.64	29.44	29.86
Proximate.	Fixed carbon	60.27	60.03	57.62
Proximate. / Ultimate.	Ash	8.19	8.32	10.23
Ultimate.	Sulphur	.75	.80	1.06
Ultimate.	Hydrogen			4.99
Ultimate.	Carbon			75.13
Ultimate.	Nitrogen			1.42
Ultimate.	Oxygen			7.17
Calorific value determined:				
	Calories	7,745		7,532
	British thermal units	13,941		13,558

Boiler test: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 9.08 pounds; dry coal consumed per electrical horsepower per hour, 3.84 pounds.

Coking test: Washed and unwashed coal yielded coke of gray color, brittle, and somewhat high in ash.

Washing test: Washing had little effect in improving quality of the coke made.

Briquetting test: Tests indicated that under certain conditions, with right temperature and pressure, briquets can be made from this coal without any binder.

West Virginia, No. 4.—Operator, Elkins Coal Company. Mine No. 2, at Bretz, Preston County. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	3.57	3.47	3.91
Proximate.	Volatile matter	27.38	28.65	26.68
Proximate.	Fixed carbon	62.84	62.70	59.30
Proximate. / Ultimate.	Ash	6.21	5.18	10.11
Ultimate.	Sulphur	.85	.80	1.07
Ultimate.	Hydrogen			4.69
Ultimate.	Carbon			74.73
Ultimate.	Nitrogen			1.56
Ultimate.	Oxygen			7.84
Calorific value determined:				
	Calories	7,899		7,428
	British thermal units	14,218		13,370

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.29 pounds.

Coking test: Very good coke made from raw and from washed coal. Crushed raw coal burned 57 hours gave 75.53 per cent coke.

Washing test: Washing coal crushed to 2 inches in modified Stewart jig did not improve coke enough to justify washing.

West Virginia, No. 4 B.—Operator, West Virginia Coal Company. Mine, Bretz, 4 miles northeast of Kingwood, Preston County. Seam, Upper Freeport. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	2.26	2.26	1.48
	Volatile matter	28.71	28.53	28.58
	Fixed carbon	61.29	60.63	61.55
	Ash	7.74	8.58	8.39
Ultimate.	Sulphur	.85	1.26	.90
	Hydrogen			4.89
	Carbon			77.82
	Nitrogen			1.48
	Oxygen			6.52
Calorific value determined:				
	Calories	7,777		7,816
	British thermal units	13,999		14,069

Boiler test: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 9.65 pounds; dry coal consumed per electrical horsepower per hour, 3.62 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.29 pounds.

Coking test: Both washed and unwashed coal yielded coke of good color, the yield from a charge of unwashed coal burned 65 hours being 74.2 per cent.

Washing test: Washing apparently had little or no effect in reducing ash in coke made from this coal.

West Virginia, No. 5.—Operator, Davis Colliery Company. Mine, Coalton, at Coalton, Randolph County. Seam, Upper Freeport. Kind of coal, bituminous, over 1½-inch screen.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	2.82	3.08	1.45
	Volatile matter	29.62	28.77	28.97
	Fixed carbon	57.11	57.88	59.48
	Ash	10.45	10.27	10.10
Ultimate.	Sulphur	1.00	1.13	.98
	Hydrogen			4.83
	Carbon			75.75
	Nitrogen			1.47
	Oxygen			6.87
Calorific value determined:				
	Calories	7,486		7,621
	British thermal units	13,475		13,718

Boiler test: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 9.59 pounds; dry coal consumed per electrical horsepower per hour, 3.81 pounds.

Coking test: Washed or unwashed coal yields coke in beehive oven, but coke from washed coal is lower in ash.

Washing test: A charge of pulverized coal washed by a New Century jig showed a reduction in ash content from 10.13 to 8.19; in sulphur, from 0.90 to 0.79.

West Virginia, No. 6.—Operator, New River Smokeless Coal Company. Mine, Rush Run, at Rush Run, Fayette County. Seam, Quinnimont. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	2.29	2.10	1.53
	Volatile matter	22.65	22.67	21.54
	Fixed carbon	69.18	71.68	71.88
	Ash	5.88	3.55	5.05
Ultimate.	Sulphur	.73	.75	.65
	Hydrogen			4.76
	Carbon			82.87
	Nitrogen			1.68
	Oxygen			4.99
Calorific value determined:				
	Calories		8,278	8,226
	British thermal units		14,900	14,807

Boiler test, better of two trials: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 10.30 pounds; dry coal consumed per electrical horsepower per hour, 3.39 pounds.

Coking test: Three tests made, all of unwashed coal, best result was with pulverized coal burned 44 hours, yield being 73.1 per cent of dense, tough coke which was light in weight and color and of poor ring.

Briquetting test: With 5 per cent of a coal-tar pitch briquets of excellent quality were made; they were hard, strong, did not disintegrate on exposure, and in burning held together without caking until entirely consumed.

West Virginia, No. 7.—Operator, New River Smokeless Coal Company. Mine, Sun, No. 1, at Sun, Fayette County. Seam, Sewall. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	2.48	2.12	3.94
	Volatile matter	21.28	21.74	19.88
	Fixed carbon	72.09	72.59	71.25
	Ash	4.15	3.55	4.93
Ultimate.	Sulphur	1.08	.90	1.16
	Hydrogen			4.60
	Carbon			79.78
	Nitrogen			1.01
	Oxygen			8.52
Calorific value determined:				
	Calories		8,286	7,990
	British thermal units		14,915	14,382

Boiler test: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 9.85 pounds; dry coal consumed per electrical horsepower per hour, 3.55 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.46 pounds.

Coking test: Charge of unwashed coal produced 64 per cent ot coke of good size and quality, but rather dark in color.

West Virginia, No. 8.—Operator, Gauley Mountain Coal Company. Mine, Gauley Mountain, at Ansted, Fayette County. Seam, Ansted. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	1.90	1.84	4.16
	Volatile matter	33.34	33.00	31.28
	Fixed carbon	59.89	58.40	57.39
Proximate. / Ultimate.	Ash	4.87	6.76	7.17
Ultimate.	Sulphur	.64	.89	.90
	Hydrogen			5.32
	Carbon			76.70
	Nitrogen			1.34
	Oxygen			8.57
Calorific value determined:				
	Calories	8,029		7,659
	British thermal units	14,452		13,786

Boiler test: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 9.62 pounds; dry coal consumed per electrical horsepower per hour, 3.63 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.78 pounds.

Coking test: A charge of unwashed coal burned 66 hours yielded 64.7 per cent of coke; this coke was hard, of good color, but of somewhat irregular cell structure.

West Virginia, No. 9.—Operator, Mount Carbon Coal Company (Limited). Mine, Vulcan, 1 mile above Powellton, Fayette County. Seam, Powellton. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	1.98	1.77	4.08
	Volatile matter	34.41	32.53	28.61
	Fixed carbon	59.85	62.76	60.73
Proximate. / Ultimate.	Ash	3.76	2.94	6.58
Ultimate.	Sulphur	.85	.74	.77
	Hydrogen			5.23
	Carbon			76.89
	Nitrogen			1.58
	Oxygen			8.95
Calorific value determined:				
	Calories	8,188		7,736
	British thermal units	14,738		13,925

Boiler test: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 10.09 pounds; dry coal consumed per electrical horsepower per hour, 3.46 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.59 pounds.

Coking test and washing tests: Washed coal produced high-grade coke; 11,000 pounds of coal burned 66 hours gave 6,803 pounds, or 61.8 per cent, coke, and only 78 pounds of ash and breeze. Charge of unwashed coal produced good, heavy, but slightly brittle coke, yield being 60.8 per cent. By washing, the ash in the coal tested was reduced from 8.07 to 4.51.

West Virginia, No. 10.—Operator, Stuart M. Buck. Mine at Mora, Mercer County. Seam, No. 6. Kind of coal, bituminous, over ⅝-inch screen.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	2.93	2.63	1.75
	Volatile matter	18.10	19.50	18.59
	Fixed carbon	73.35	74.74	75.08
	Ash	3.62	3.13	4.58
Ultimate.	Sulphur	.48	.57	.56
	Hydrogen			4.65
	Carbon			84.97
	Nitrogen			1.06
	Oxygen			4.18
Calorific value determined:				
	Calories	8,291		8,346
	British thermal units	14,924		15,023

Boiler test: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 9.65 pounds; dry coal consumed per electrical horsepower per hour, 3.62 pounds.

Coking test: A charge of 11,000 pounds of unwashed coal burned 68 hours yielded 7,858 pounds, or 71.4 per cent, of good, hard, heavy coke.

West Virginia, No. 11.—Operator, W. H. Coffman. Mine, Zenith 1 and 2, at Zenith, McDowell County. Seam, Pocahontas. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	2.21	3.05	4.07
	Volatile matter	18.28	18.26	16.34
	Fixed carbon	74.26	74.12	68.47
	Ash	5.25	4.57	11.12
Ultimate.	Sulphur	.44	.50	.51
	Hydrogen			4.27
	Carbon			76.51
	Nitrogen			1.00
	Oxygen			6.59
Calorific value determined:				
	Calories	8,218		7,505
	British thermal units	14,792		13,509

Boiler test: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 10.03 pounds; dry coal consumed per electrical horsepower per hour, 3.48 pounds.

Coking test: Only West Virginia coal tested at plant during 1904, which did not coke in a beehive oven.

West Virginia, No. 12.—Operator, Big Sandy Coal and Coke Company. Mine, Big Sandy, McDowell County. Seam, No. 8. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	1.92	3.48	1.72
	Volatile matter	19.36	18.89	17.85
	Fixed carbon	74.33	73.73	73.56
	Ash	4.39	3.90	6.87
Ultimate.	Sulphur	.52	.73	.68
	Hydrogen			4.43
	Carbon			82.71
	Nitrogen			1.33
	Oxygen			3.98
Calorific value determined:				
	Calories	8,292	8,184	8,095
	British thermal units	14,926	14,731	14,571

Boiler test: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 9.90 pounds; dry coal consumed per electrical horsepower per hour, 3.53 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.50 pounds.

Coking test: Made good coke.

Washing test: Washing reduced the ash content of the coke, but did not decrease sulphur.

West Virginia, No. 13.—Operator, Loup Creek Colliery Company. Mine, Page No. 2, at Page, Fayette County. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	5.48	2.93	3.74
	Volatile matter	29.70	31.95	31.04
	Fixed carbon	62.53	60.17	61.31
	Ash	2.29	4.95	3.91
Ultimate.	Sulphur	.79	1.22	.89
	Hydrogen			5.31
	Carbon			80.50
	Nitrogen			1.32
	Oxygen			8.07
Calorific value determined:				
	Calories	8,030		8,020
	British thermal units	14,454		14,436

Boiler tests: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 10.50 and 10.58 pounds; dry coal consumed per electrical horsepower per hour, 3.32 and 3.30 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.01 pounds.

Coking test: Crushed raw coal made good, hard silvery foundry coke; charge burned 84 hours yielded 69.73 per cent coke, containing 4.84 per cent ash and 0.77 per cent sulphur.

West Virginia, No. 14.—Operator, Loup Creek Colliery Company. Mine, Page No. 1, at Page, Fayette County. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.			Car sample.
Proximate.	Moisture	3.53	2.96	4.11	5.09
	Volatile matter	29.36	30.23	29.08	29.07
	Fixed carbon	64.77	59.37	59.36	62.57
	Ash	2.34	7.44	7.45	3.27
Ultimate.	Sulphur	.92	1.04	.80	1.03
	Hydrogen				5.33
	Carbon				78.23
	Nitrogen				1.51
	Oxygen				10.63
Calorific value determined:					
	Calories		7,762		7,839
	British thermal units		13,972		14,110

Boiler test: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 10.52 and 9.60 pounds; dry coal consumed per electrical horsepower per hour, 3.32 and 3.64 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.06 pounds.

Coking test: Crushed raw coal burned 71 hours made 65.04 per cent good foundry coke, containing 3.47 per cent ash and 0.94 per cent sulphur.

West Virginia, No. 15.—Operator, Fairmont Coal Company. Mine, Ocean, 3 miles west of Clarksburg, Harrison County. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	2.80	3.27	2.01
	Volatile matter	38.51	37.72	37.31
	Fixed carbon	53.14	53.27	52.13
	Ash	5.55	5.74	8.55
Ultimate.	Sulphur	2.40	2.41	2.54
	Hydrogen			5.08
	Carbon			75.83
	Nitrogen			1.43
	Oxygen			6.57
Calorific value determined:				
	Calories	7,836		7,673
	British thermal units	14,105		13,811

Boiler test: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 8.99 and 8.65 pounds; dry coal consumed per electrical horsepower per hour, 3.88 and 4.04 pounds.

Coking test: Crushed raw coal burned 73 hours gave 70.03 per cent fine, heavy coke, high in sulphur (2.26 per cent).

West Virginia, No. 16.—Mine, Monongah, No. 6, at Monongah, Marion County. Kind of coal, bituminous, over ¾-inch screen and slack.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	2.89	2.68	5.57
	Volatile matter	34.54	35.97	31.61
	Fixed carbon	56.86	55.78	54.45
	Ash	5.71	5.57	8.37
Ultimate.	Sulphur	.69	1.06	1.20
	Hydrogen			5.08
	Carbon			72.74
	Nitrogen			1.46
	Oxygen			11.15
Calorific value determined:				
	Calories	7,800		7,274
	British terminal units	14,540		13,093

Producer-gas test, coal over ¾-inch screen: Dry coal consumed per electrical horsepower per hour, 1.37 pounds.

Washing test: Slack washed by modified Stewart jig showed reduction of ash from 8.37 to 5.91 per cent, and of sulphur from 1.20 to 0.92 per cent.

Coking test: Coke from washed coal lower in sulphur and ash than coke from raw coal, but physical properties not as good. Raw ¾-inch coal, crushed, burned 60 hours gave 69.29 per cent fine, heavy coke, containing 9.08 per cent ash and 0.81 per cent sulphur.

West Virginia, No. 17.—Operator, Elkins Coal Company. Mine, country bank, 2½ miles above Bretz, Preston County. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	3.22	4.05	3.46
	Volatile matter	29.64	28.70	27.29
	Fixed carbon	59.91	61.65	61.13
	Ash	7.33	5.60	8.12
Ultimate.	Sulphur	1.73	1.16	1.45
	Hydrogen			4.68
	Carbon			76.98
	Nitrogen			1.37
	Oxygen			7.40
Calorific value determined:				
	Calories	7,775		7,705
	British thermal units	13,995		13,869

Boiler test, rocking grate: Water evaporated by 1 pound of dry coal, at and from a temperature of 212° F., 10.22 and 9.94 pounds; dry coal consumed per electrical horsepower per hour, 3.42 and 3.51 pounds.

Coking test: Made good coke for outcrop coal.

Washing test: Ash reduced from 8.12 to 5.50 per cent by crushing coal to 2 inches and washing in modified Stewart jig.

West Virginia, No. 18.—Operator, Glen Alum Fuel Company. Mine, Glen Alum, at Glen Alum, Mingo County. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	2.81	4.04	2.86
	Volatile matter	31.67	31.25	33.23
	Fixed carbon	59.02	59.55	58.08
	Ash	6.50	5.16	5.83
Ultimate.	Sulphur	2.06	.64	.67
	Hydrogen			5.01
	Carbon			78.38
	Nitrogen			1.43
	Oxygen			8.68
Calorific value determined:				
	Calories	7,754		7,836
	British thermal units	13,957		14,106

Boiler test with rocking grate, better of two runs: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 10.49 pounds; dry coal consumed per electrical horsepower per hour, 3.33 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.17 pounds.

Coking test: Crushed raw coal burned 48 hours gave 70.18 per cent good, hard, heavy coke; ash content, 8.65 per cent; sulphur, 0.53 per cent.

West Virginia, No. 19.—Operator, White Oak Coal Conpany. Mine, McDonald, at McDonald, Fayette County. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	3.26	3.51	2.96
	Volatile matter	21.57	21.11	22.74
	Fixed carbon	72.71	72.83	69.29
	Ash	2.46	2.55	5.01
Ultimate.	Sulphur	.78	.53	.89
	Hydrogen			4.81
	Carbon			81.64
	Nitrogen			1.57
	Oxygen			6.08
Colorific value determined:				
	Calories	8,207		8,014
	British thermal units	14,773		14,425

Boiler test: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 10.26 pounds; dry coal consumed per electrical horsepower per hour, 3.40 pounds.

Coking test: Crushed raw coal burned 53 hours gave 65.95 per cent dull-gray, small-celled coke, containing 7.43 per cent ash and 0.82 per cent sulphur.

West Virginia, No. 20.—Operator, Stevens Coal Company. Mine, Keystone, at Acme, Kanawha County. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car samples.	
Proximate.	Moisture	2.66	2.84	2.82	2.89
	Volatile matter	33.30	33.18	32.20	32.53
	Fixed carbon	59.60	58.75	56.95	56.95
	Ash	4.44	5.23	8.03	7.63
Ultimate.	Sulphur	1.14	1.35	1.38	1.50
	Hydrogen			5.16	
	Carbon			76.74	
	Nitrogen			1.34	
	Oxygen			7.35	
Calorific value determined:					
	Calories	7,982		7,648	
	British thermal units	14,368		13,766	

Boiler test, with rocking grate: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 10.11 and 10.04 pounds. Dry coal consumed per electrical horsepower per hour, 3.45 and 3.48 pounds. With washed coal, using rocking grate, the figures were 10.46 pounds water and 3.34 pounds coal.

Producer-gas test: Dry coal consumed per electrical horsepower per hour, 1.29 pounds.

Washing test: Washing coal crushed to 2 inches in modified Stewart jig reduced ash from 8.03 to 4.64, but did not materially change sulphur.

Coking test: Washed and unwashed coal made good coke low in ash and sulphur; coke from washed coal of better physical character. Crushed raw coal burned 42 hours gave 69.88 per cent fine heavy coke, containing 7.48 per cent ash and 1.44 per cent sulphur.

West Vivginia, No. 21.—Operator, Winifred Coal Company. Mine, Gas, at Winifred, Kanawha County. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	3.57	3.72	3.57
	Volatile matter	36.76	35.95	36.38
	Fixed carbon	56.05	56.21	55.20
	Ash	3.62	4.12	4.85
Ultimate.	Sulphur	1.14	1.16	1.32
	Hydrogen			5.33
	Carbon			77.49
	Nitrogen			1.49
	Oxygen			9.52
Calorific value determined:				
	Calories	7,874		7,749
	British thermal units	14,173		13,948

Boiler test: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 10.20 and 10.03 pounds; dry coal consumed per electrical horsepower per hour, 3.42 and 3.48 pounds.

Coking test: Washed or unwashed coal makes good foundry coke; coke from unwashed coal, better. Charge of unwashed coal burned 52 hours gave 67.55 per cent of coke, containing 7.72 per cent ash and 0.98 per cent sulphur.

Washing test: Washing in modified Stewart jig of no commercial advantage.

WYOMING.

Total production in 1905, 5,602,021 short tons; spot value, $7,336,951.

In each of the last 3 years the coal output of Wyoming has made increases over the preceding year, and in each has the production been the maximum up to that time. The gain in each of the last 2 years has been approximately 500,000 short tons, the increase in 1904 over 1903 being 543,263 short tons, or not quite 12 per cent, while that of 1905 over 1904 was 423,465 short tons, or 8.2 per cent. This increased production has been due to a legitimate demand and not to any attempt to force production, for it is observed that with the gain in output there has been an advance in values, the average price per ton having risen from $1.24 in 1903, to $1.30 in 1904, and to $1.31 in 1905. The increase in the value of the product was $589,042, or 8.7 per cent, in 1905, as compared with 1904, which in turn showed a gain of $1,016,628, or nearly 18 per cent, over 1903.

The statistics of labor employed in the Wyoming coal mines during 1905 show that there were 5,977 men who worked an average of 236 days, from which it is seen that, considered with the output for last year, the average production for each man employed was 937.3 tons, and that the average tonnage per day per man was 3.97. In 1904 the average tonnage per man for the year was 914.9 and the average daily tonnage was 3.49, while in 1903 the corresponding figures were 928.4 and 3.68. Wyoming, with Colorado and Utah, of the Rocky Mountain division, and Maryland and Pennsylvania (bituminous), in the East, hold the record for individual capacity among the mine workers. In all but two of the States, Utah and Pennsylvania (bituminous), the large majority of the mines work 10 hours per day. In Wyoming during 1905, 26 mines out of a total of 34, and employing 5,492 men out of a total of 5,977, worked 10 hours, and 2 mines, employing 456 men, worked 9 hours.

The casualty record for 1905, as reported by Messrs. A. E. Bradbury and Noah Young, State inspectors of coal mines, shows that there were 20 accidents, 12 of which resulted fatally. Eleven of the 12 men killed were married, and 23 children were left fatherless.

The statistics relating to the use of mining machines show that there was in use in Wyoming during 1905 a total of 81 machines, as compared with 72 in 1904, and 59 in 1903. The machine-mined production has increased from 783,822 short tons, or 16.91 per cent of the total in 1903, to 1,053,702 short tons, or 20.35 per cent of the total in 1904, to 1,236,750 tons or 22.1 per cent, in 1905.

Of the the total number of machines in use in 1905, 49 were of the pick or puncher type, 26 chain breast, and 6 were long-wall machines.

In the following tables is shown the production of coal in Wyoming in 1904 and 1905, by counties, with the distribution of the product for consumption:

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.

Coal production of Wyoming in 1905, 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	2,033,965	10,576	69,438	....	2,113,979	$2,888,790	$1.37	275	2,314
Uinta	1,816,164	8,425	73,079	....	1,897,668	2,338,134	1.23	153	1,711
Other counties [a]	1,459,007	30,707	87,133	10,857	1,587,704	2,104,075	1.33	264	1,952
Small mines	....	2,670	....	....	2,670	5,952	2.23	....	....
Total	5,309,136	52,378	229,650	10,857	5,602,021	7,336,951	1.31	236	5,977

[a] Bighorn, Carbon, Converse, Crook, Fremont, Johnson, Sheridan, and Weston.

In the following table is shown the production, by counties, during the last 5 years, with the increases and decreases in 1905 as compared with 1904:

Coal production of Wyoming, 1901–1905, by counties.

[Short tons.]

County.	1901.	1902.	1903.	1904.	1905.	Increase or decrease, 1905.
Bighorn	....	902	....	6,235	4,605	− 1,630
Carbon	530,626	382,207	243,323	336,292	354,358	+ 18,066
Converse	59,190	72,329	91,050	77,386	64,939	− 12,447
Sheridan	221,000	309,066	455,309	554,785	742,314	+ 187,529
Sweetwater	1,705,880	1,595,340	1,628,944	1,992,993	2,113,979	+ 120,986
Uinta	1,439,147	1,595,333	1,782,668	1,800,069	1,897,668	+ 97,599
Weston	507,908	457,801	416,974	398,367	409,690	+ 11,323
Crook, Fremont, Johnson, Natrona	21,623	16,513	14,934	9,254	11,798	+ 2,544
Small mines	....	....	2,091	3,175	2,670	− 505
Total	4,485,374	4,429,491	4,635,293	5,178,556	5,602,021	+ 423,465
Total value	$6,060,462	$5,236,339	$5,731,281	$6,747,909	$7,336,951	+$589,042

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 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.

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, 1865–1905.

[Short tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1865	800	1879	400,991	1893	2,439,311
1866	2,500	1880 [a]	589,595	1894	2,417,463
1867	5,000	1881	420,000	1895	2,246,911
1868	6,925	1882	707,764	1896	2,229,624
1869	49,382	1883	779,689	1897	2,597,886
1870 [a]	50,000	1884	902,620	1898	2,863,812
1871	147,328	1885	807,328	1899	3,837,392
1872	221,745	1886	829,355	1900	4,014,602
1873	259,700	1887	1,170,318	1901	4,485,374
1874	219,061	1888	1,481,540	1902	4,429,491
1875	300,808	1889	1,388,947	1903	4,635,293
1876	334,550	1890	1,870,366	1904	5,178,556
1877	342,853	1891	2,327,841	1905	5,602,021
1878	333,200	1892	2,503,839		

[a] United States census, fiscal year.

RESULTS OF TESTS OF WYOMING COALS.

The more important features of the results of tests made on Wyoming coals at the Geological Survey coal-testing plant [a] at St. Louis, Mo., are briefly summarized below. For more detailed reports see Professional Paper No. 48 and Bulletin No. 290 of the United States Geological Survey.

[a] For brief description of the equipment used in these tests see page 6.

Wyoming, No. 1.—Operator, Wyoming Coal Mining Company. Mine, Monarch, 9 miles northwest of Sheridan, Sheridan County. Kind of coal, black lignite, over 5-inch screen.

Chemical analyses.

		Mine samples.		Car sample.
Proximate.	Moisture	22.00	21.44	22.63
	Volatile matter	35.92	37.16	35.68
	Fixed carbon	38.71	36.49	37.19
	Ash	3.37	4.91	4.50
Ultimate.	Sulphur	.60	.53	.59
	Hydrogen			6.39
	Carbon			54.91
	Nitrogen			1.02
	Oxygen			32.59
Calorific value determined:				
	Calories	5,442		5,408
	British thermal units	9,796		9,734

Boiler test: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 7 pounds; dry coal consumed per electrical horsepower per hour, 4.99 pounds.

Briquetting test: Best briquets made at plant during 1904 from lignite were obtained with 8 per cent of a soft pitch. Certain grades of asphalt will undoubtedly make good briquets.

Wyoming, No. 2.—Operator, Cambria Fuel Company. Mines, Antelope, No. 1 and No. 2, at Cambria, Weston County. Kind of coal, bituminous, run of mine.

Chemical analyses.

		Mine samples.		Car samples.	
Proximate.	Moisture	8.60	9.23	8.93	9.44
	Volatile matter	37.13	36.08	36.52	35.02
	Fixed carbon	32.37	33.72	33.76	34.82
	Ash	21.90	20.97	20.79	20.72
Ultimate.	Sulphur	4.94	4.33	4.03	3.91
	Hydrogen			4.88	5.00
	Carbon			53.33	51.46
	Nitrogen			.81	.74
	Oxygen			16.16	18.17
Calorific value determined:					
	Calories	5,394		5,556	5,361
	British thermal units	9,709		10,001	9,650

Boiler tests, with rocking grate, unwashed coal, better of two trials: Water evaporated by 1 pound of dry coal at and from a temperature of 212° F., 7.04 pounds; dry coal consumed per electrical horsepower per hour, 4.96 pounds. Washed coal, water evaporated, 8.07 pounds; coal consumed, 4.33 pounds. Unwashed coal, plain grate, water evaporated, 5.92 pounds; coal consumed, 5.90 pounds.

Producer-gas test: Dry coal consumed per electrical horsepower per hour (better of two trials), 1.78 pounds.

Coking test: Crushed washed coal would not coke in beehive oven.

Washing test, in modified Stewart jig: Raw coal, ash, 16.70; sulphur, 6.66 per cent; washed coal, ash, 6.52; sulphur, 4.16 per cent; decided reduction in ash.

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 in many cases a high-grade metallurgical fuel and intended for such use, 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 some manufacturers of beehive coke are now making a specialty of the preparation of coke for domestic use, and considerable quantities of this fuel are sold each 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-Hoffmann 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 acknowledgment of the assistance rendered by Miss Belle Hill 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 ovens, which in 1905 amounted to 3,462,348 short tons, the total output of coke in the United States last year amounted to 32,231,129 short tons, against 23,661,106 short tons in 1904, and 25,274,281 short tons in 1903. The production in 1905 surpassed all previous records in the history of coke making in the United States. Compared with 1904 the output last year shows an increase of 8,570,023 short tons, or 36.22 per cent.

The value increased in even greater proportion, from $46,144,941 in 1904 to $72,476,196 in 1905, a gain of $26,331,255, or 57 per cent. Prior to 1905 the maximum production of coke was made in 1902, when the output amounted to 25,401,730 short tons, valued at $63,339,167, compared with which the production last year shows an increase of 6,829,399 short tons, or 26.8 per cent in quantity, and of $9,137,029, or 14.4 per cent in value.

The great activity in the coke-making industry in 1905 was due to the extraordinary demand created by the unprecedented production of iron and steel, and except for a short time during the summer months when furnaces were shut down for repairs the demand for coke was in excess of the supply throughout the year. Prices were considerably above the average for recent years, there being but three years in the last twenty-five in which higher prices have obtained, and in two of these, 1902 and 1903, values were abnormally augmented by the fuel famine, resulting from the anthracite strike of 1902. The average price for all the coke made and sold or consumed in 1905 was $2.25, against $1.95 in 1904.

In considering the total value and the average selling price for the coke produced in the United States it should be remembered that in many cases the values are arbitrarily fixed. A considerable number of the coke ovens in this country are operated by large corporations which operate also coal mines and blast furnaces, the coke making being really only an incidental part of the business. In such cases the coke product is sometimes charged against the furnace department 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 amount of coal used in the manufacture of coke in 1905 was 49,530,677 short tons, valued at $50,614,674. The value of the coke produced from this coal was $72,476,196, making a difference of $21,861,522 as representing the profits on the coking operations, less the cost of manufacture and the expenses of administration 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 to cover all expenses and profits of $8,892,351.

The year 1905 opened with the iron trade active and coke in such demand that prices in January were sharply advanced over the closing month of 1904. In December, 1904, Connellsville furnace coke was quoted at $2.45, the highest point reached in the year, and by the middle of January, 1905, the price had advanced to $3 per ton for quick delivery and contracts were made at $2.50 a ton for delivery in the latter half of the year. High-grade foundry coke was quoted during January at from $3.35 to $3.50. With nearly every plant running to full capacity during January and February the supply caught up somewhat with the demand and prices were shaded, Connellsville furnace falling off to $2.50 and foundry to $3. These conditions continued with prices firm until April, when demand fell off somewhat and stocks of coke began to accumulate, and by May prices began to sag, strictly Connellsville coke being quoted at $1.80 to $1.90 for furnace and $2.50 for foundry. This was evidently the forerunner of the summer dullness, which came rather early, and during June and the first half of July business was without life and a number of plants were put out of blast. A turn for the better took place in the latter part of July, and from then until the the close of the year there was an active demand accompanied by advancing prices. Connellsville furnace coke, which was selling as low as from $1.70 to $1.75 in the early part of July, advanced to $2 to $2.10 by the end of the month, while foundry was quoted at $2.25 to $2.50. Business continued good with slight variations in price until the first of October, when it again assumed a boom character and prices jumped to $2.50 to $2.60 for Connellsville furnace and $3 for foundry. By November there was a scarcity of fuel and prices had still further advanced until furnace coke was quoted at $3 and foundry from $3.50 to $3.75. Demand continued in excess of the supply for the rest of the year with prices firm at these figures.

The total number of ovens in existence at the close of 1905 was 87,564 against 83,599 in 1904, an increase of 3,965. Of the total number of ovens in existence in 1905 there were 5,932 which were idle during the entire year, leaving 81,632 active ovens, which produced 32,231,129 tons of coke, or an average of 394.8 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 idle ovens in both years, with a few exceptions, were at plants which have not been operated for several years and are practically abandoned, or were new ovens completed too late to be put in blast during the year.

The total number of 87,564 ovens in 1905 included 3,159 by-product recovery ovens, of which 161 were idle and 2,988 were operated during the year. The production from these 2,988 by-product ovens was 3,462,348 tons of coke, which, deducted from the total production of 32,231,129 tons, leaves 28,768,781 tons as the output of 78,644 active beehive ovens. From this it appears that the average production from the by-product ovens was 1,158.8 tons, while the average output from each beehive oven was 365.8 tons. In other words, the average production from the by-product ovens is more than three times that from the beehive. In 1904 there were 74,111 active beehive ovens which produced 21,013,291 tons of coke, an average of 283.5 tons per oven, and 2,910 by-product recovery ovens which produced 2,608,229 tons of coke, or 896 tons per oven.

There were under construction at the close of 1905 4,751 new ovens, of which 417, or 8.8 per cent, were of the retort or by-product type. Of the by-product ovens under construction at the close of 1905, 240 were Semet-Solvay, 160 of which were building at Steelton, Pa., and 80 were building at Milwaukee, Wis. The other 177 were of the Otto-Hoffmann type, 15 of which were being added to the plant of the Michigan Alkali Company at Wyandotte, Mich., duplicating the plant, 112 were building by the Cambria Steel Company at Johnstown (making the total number at this plant 372), and 50 were being added to the 100 ovens already built at Camden, N. J.

The number of completed retort ovens in the United States has almost doubled since 1902, when there were 1,663 in operation. The number increased to 1,956 in 1903, to 2,910 in 1904, and to 3,159 in 1905. The production of retort-oven coke was 1,403,588 tons in 1902, 1,882,394 tons in 1903, 2,608,229 tons in 1904, and 3,462,348 tons in 1905. In 1902, 5.5 per cent of the total output was from by-product ovens; in 1903 by-product coke constituted 7.4 per cent of the total; in 1904 it was 11 per cent, and in 1905 it was 10.7 per cent.

Counting each bank of ovens as a separate establishment, the returns for 1905 show a total of 519 establishments as compared with 506 in 1904 and 500 in 1903. Seventy-five establishments were idle throughout the year as compared with 82 idle plants in 1904. There were also 10 new establishments, having a total of 890 ovens, which were not completed and put in blast before the close of 1905.

The details of the production of coke in 1904 and 1905 are presented by States and Terrtories in the following tables:

Manufacture of coke in the United States, by States and Territories, in 1904.

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	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
New Mexico	3	234	0	94,397	61.7	58,259	171,976	2.95
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	2,015,281	72	1,451,172	4,777,403	3.29
New Jersey	1	100	0					
New York	3	352	658					
Wisconsin	2	308	0					
Wyoming	1	74	0					
Total	507	83,599	4,430	36,531,608	64.8	23,661,106	46,144,941	1.95

[a] Includes the production of Utah.

[b] Included with Colorado.

Manufacture of coke in the United States, by States and Territories, in 1905.

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	9,586	150	4,409,854	58.4	2,576,986	$7,646,957	$2.967
Colorado[a]	15	3,421	0	2,368,365	58.2	1,378,824	4,157,517	3.02
Georgia	2	533	0	119,036	59.3	70,593	224,260	3.18
Illinois	5	275	0	16,821	61.3	10,307	27,681	2.685
Indiana	1	36	....	....	....	....	....	....
Indian Territory	5	388	50	123,389	44.4	54,781	199,424	3.64
Kansas	6	91	0	6,504	68.0	4,425	13,818	3.12
Kentucky	6	495	0	154,783	51.4	79,487	159,659	2.008
Missouri	2	6	0	2,551	61.9	1,580	4,072	2.577
Montana	4	555	100	68,777	45.8	31,482	211,351	6.71
New Mexico	3	258	498	148,469	60.4	89,638	253,229	2.825
Ohio	8	573	0	396,961	69.8	277,130	970,897	3.50
Pennsylvania	226	42,608	2,384	31,030,345	66.3	20,573,736	42,253,178	2.054
Tennessee	16	2,615	60	862,320	54.3	468,092	1,184,442	2.53
Utah	2	504	150	(b)	....	(b)	(b)	....
Virginia	16	4,549	0	2,184,369	68.6	1,499,481	2,869,452	1.913
Washington	5	216	0	85,715	62	53,137	251,717	4.737
West Virginia	143	19,189	1,214	5,329,695	63.8	3,400,593	6,548,205	1.92
Maryland	1	200	0	2,222,723	74.7	1,660,857	5,500,337	3.31
Massachusetts	1	400	0					
Michigan	2	135	15					
Minnesota	1	50	0					
New Jersey	1	100	50					
New York	3	399	0					
Wisconsin	2	308	80					
Wyoming	1	74	0					
Total	519	87,564	4,751	49,530,677	65.07	32,231,129	72,476,196	2.249

[a] Includes the production of Utah. [b] Included with Colorado.

Of the 25 States and Territories in which coke was produced in 1905 there were only 4 whose production in 1905 did not exceed that of 1904. All of these 4 were comparatively unimportant producers, their combined output amounting to less than 110,000 tons. The 4 States in which the production decreased in 1905 were Georgia, Kansas, Missouri, and Montana, and the total decreases amounted to 21,135 tons. The increases in the 21 other States amounted to 8,591,158 tons, making the net increase for the United States 8,570,023 tons. The production from by-product ovens increased from 2,608,229 tons in 1904 to 3,462,348 tons in 1905, a gain of 854,119 tons, or 32.75 per cent. The production of beehive coke increased from 21,013,291 tons in 1904 to 28,768,781 tons in 1905, a gain of 7,655,490 tons, or 36.43 per cent.

The most notable increases in 1905 were made in Pennsylvania, whose production increased 5,712,672 tons, or 38.44 per cent; West Virginia, whose increase was 1,117,507 tons, or 48.95 per cent; Colorado (including Utah), increase 589,764 tons, or 74.74 per cent, and Virginia, increase 397,765 tons, or 36.10 per cent. Ohio led in the percentage of increase with a gain of 153.6 per cent, and Illinois came second with an increase of 132.2 per cent, but the tonnage (particularly in Illinois) is small. Alabama shows the smallest percentage of increase of all the coke-producing States.

The increases and decreases in the several States during 1905, as compared with 1904, are shown in the following table:

Increases and decreases in coke production, by States, in 1905, as compared with 1904.

[Short tons.]

State or Territory.	Total quantity.		Increase.		Decrease.	
	1905.	1904.	Quantity.	Per cent.	Quantity.	Per cent.
Alabama	2,576,986	2,340,219	236,767	10.12		
Colorado[a]	1,378,824	789,060	589,764	74.74		
Georgia	70,593	75,812			5,219	6.88
Illinois	10,307	4,439	5,868	132.19		
Indian Territory	54,781	44,808	9,973	22.26		
Kansas	4,425	9,460			5,035	53.22
Kentucky	79,487	64,112	15,375	23.98		
Missouri	1,580	2,446			866	35.40
Montana	31,482	41,497			10,015	24.13
New Mexico	89,638	58,259	31,379	53.86		
Ohio	277,130	109,284	167,846	153.59		
Pennsylvania	20,573,736	14,861,064	5,712,672	38.44		
Tennessee	468,092	379,240	88,852	23.43		
Virginia	1,499,481	1,101,716	397,765	36.10		
Washington	53,137	45,432	7,705	16.96		
West Virginia	3,400,593	2,283,086	1,117,507	48.95		
Maryland Massachusetts Michigan Minnesota New Jersey New York Wisconsin Wyoming	1,660,857	1,451,172	209,685	14.45		
Total	32,231,129	23,661,106	8,570,023	36.22		

[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 for 1903, 1904, and 1905 was 27,055,505 short tons, an increase of 30.7 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 in 1880, 1890, and from 1900 to 1905, inclusive:

Statistics of the manufacture of coke in the United States in 1880, 1890, and 1900–1905.

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	186	12,372	1,159	5,237,741	3,338,300	$6,631,267	$1.99	63
1890	253	37,158	1,547	18,005,209	11,508,021	23,215,302	2.02	64
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	507	83,599	4,430	36,531,608	23,661,106	46,144,941	1.95	64.8
1905	519	87,564	4,751	49,530,677	32,231,129	72,476,196	2.25	65.07

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 1904 was due to a natural reaction from the abnormal production of the two preceding years, 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, 1901–1905, by States and Territories.

[Short tons.]

State or Territory.	1901.	1902.	1903.	1904.	1905.
Alabama	2,148,911	2,552,246	2,693,497	2,340,219	2,576,986
Colorado [a]	671,303	1,003,393	1,053,840	789,060	1,378,824
Georgia	54,550	82,064	85,546	75,812	70,593
Illinois	....	....	....	4,439	10,307
Indian Territory	37,374	49,441	49,818	44,808	54,781
Kansas	7,138	20,902	14,194	9,460	4,425
Kentucky	100,285	126,879	115,362	64,112	79,487
Missouri	4,749	5,780	1,839	2,446	1,580
Montana	57,004	53,463	45,107	41,497	31,482
New Mexico	41,643	23,296	11,050	58,259	89,638
Ohio	108,774	146,099	143,913	109,284	277,130
Pennsylvania	14,355,917	16,497,910	15,650,932	14,861,064	20,573,736
Tennessee	404,017	560,006	546,875	379,240	468,092

[a] Colorado includes Utah.

Quantity of coke produced in the United States, 1901–1905, etc.—Continued.

State or Territory.	1901.	1902.	1903.	1904.	1905.
Utah	(a)	(a)	(a)	(a)	(a)
Virginia	907,130	1,124,572	1,176,439	1,101,716	1,499,481
Washington	49,197	40,305	45,623	45,432	53,137
West Virginia	2,283,700	2,516,505	2,707,818	2,283,086	3,400,593
Maryland, Massachusetts, Michigan, Minnesota, New Jersey, New York, Wisconsin, Wyoming	564,191	598,869	932,428	1,451,172	1,660,857
Total	21,795,883	25,401,730	25,274,281	23,661,106	32,231,129

a Included with Colorado.

The annual production since 1880 has been as follows:

Quantity of coke produced in the United States, 1880–1905.

[Short tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1880	3,338,300	1889	10,258,022	1898	16,047,209
1881	4,113,760	1890	11,508,021	1899	19,668,569
1882	4,793,321	1891	10,352,688	1900	20,533,348
1883	5,464,721	1892	12,010,829	1901	21,795,883
1884	4,873,805	1893	9,477,580	1902	25,401,730
1885	5,106,696	1894	9,203,632	1903	25,274,281
1886	6,845,369	1895	13,333,714	1904	23,661,106
1887	7,611,705	1896	11,788,773	1905	32,231,129
1888	8,540,030	1897	13,288,984		

VALUE OF COKE PRODUCED.

In the following tables are presented statements showing the value of the coke produced in each State and Territory during the last five 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 enhanced values of the coke produced in 1902 and 1903. The extraordinary production in 1905, however, coupled with the high range of prices which obtained during the year, brought the total value up to an amount exceeding by nearly $6,000,000 the previous high-water mark of 1903.

The following tables show the value of the coke produced in each State and Territory during the last five 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, 1901–1905 by States and Territories.

State or Territory.	1901.	1902.	1903.	1904.	1905.
Alabama	$6,062,616	$8,300,838	$7,622,528	$5,716,413	$7,646,957
Colorado	[a] 1,626,279	[a] 2,754,341	[a] 3,089,783	[a] 2,590,251	[a] 4,157,517
Georgia	154,625	298,963	368,351	212,697	224,260
Illinois	....	....	....	9,933	27,681
Indian Territory	154,834	202,921	227,542	209,165	199,424
Kansas	15,079	54,702	50,221	23,485	13,818
Kentucky	208,015	317,875	305,327	138,226	159,659
Missouri	9,968	14,450	5,797	6,115	4,072
Montana	337,381	360,927	310,882	280,745	211,351
New Mexico	118,368	74,051	31,539	171,976	253,229
Ohio	299,430	492,793	528,142	337,606	970,897
Pennsylvania	27,066,361	38,451,722	38,969,101	25,027,462	42,253,178
Tennessee	952,782	1,597,041	1,706,722	905,540	1,184,442
Utah	([b])	([b])	([b])	([b])	([b])
Virginia	1,483,670	2,322,228	2,724,047	1,772,717	2,869,452
Washington	239,028	199,195	214,776	207,357	251,717
West Virginia	4,110,011	5,833,226	7,115,842	3,757,850	6,548,205
Maryland Massachusetts Michigan New Jersey New York Wisconsin Wyoming	1,607,476	2,063,894	3,228,064	4,777,403	5,500,337
Total	44,445,923	63,339,167	66,498,664	46,144,941	72,476,196

[a] Includes value of Utah coke.

[b] Included with Colorado.

Total value, at the ovens, of the coke made in the United States, 1880–1905.

Year.	Value.	Year.	Value.	Year.	Value.
1880	$6,631,265	1889	$16,630,301	1898	$25,586,699
1881	7,725,175	1890	23,215,302	1899	34,670,417
1882	8,462,167	1891	20,393,216	1900	47,443,331
1883	8,121,607	1892	23,536,141	1901	44,445,923
1884	7,242,878	1893	16,523,714	1902	63,339,167
1885	7,629,118	1894	12,328,856	1903	66,498,664
1886	11,153,366	1895	19,234,319	1904	46,144,941
1887	15,321,116	1896	21,660,729	1905	72,476,196
1888	12,445,963	1897	22,102,514		

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 quantity 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.

The year 1904 opened with prospects for a good year, but a slump in the iron trade during the summer checked production and demoralized values to such an extent that the average price for the year was the lowest since 1899. Last year was one of exceptional activity and good prices, there being but a few weeks during the early summer when demand was not up to the supply, and when prices were somewhat off. With three exceptions the average price for coke in 1905 was the highest in the last quarter of a century.

Average price per short ton, at the ovens, of the coke made in the United States, 1901–1905, by States and Territories.

State or Territory.	1901.	1902.	1903.	1904.	1905.
Alabama	$2.82	$3.25	$2.83	$2.443	$2.967
Colorado [a]	2.42	2.74	2.93	3.28	3.02
Georgia	2.83	3.643	4.306	2.806	3.18
Illinois	....	....	....	2.24	2.685
Indian Territory	4.14	4.10	4.57	4.67	3.64
Kansas	2.11	2.617	3.54	2.48	3.12
Kentucky	2.07	2.505	2.65	2.15	2.008
Missouri	2.099	2.50	3.15	2.50	2.577
Montana	5.918	6.75	6.89	6.77	6.71
New Mexico	2.84	3.178	2.85	2.95	2.825
Ohio	2.75	3.37	3.67	3.09	3.50
Pennsylvania	1.885	2.33	2.49	1.684	2.054
Tennessee	2.358	2.85	3.12	2.388	2.53
Utah	(b)	(b)	(b)	(b)	(b)
Virginia	1.635	2.065	2.315	1.609	1.913
Washington	4.858	4.94	4.71	4.56	4.737
West Virginia	1.80	2.318	2.628	1.646	1.92
Maryland, Massachusetts, Michigan, New Jersey, New York, Wisconsin, Wyoming	2.849	3.446	3.46	3.29	3.31
Average	2.039	2.49	2.63	1.95	2.249

a Includes Utah. b Included with Colorado.

Average price per short ton, at the ovens, of the coke made in the United States, 1880–1905.

Year.	Value.	Year.	Value.	Year.	Value.
1880	$1.99	1889	$1.62	1898	$1.594
1881	1.88	1890	2.02	1899	1.76
1882	1.77	1891	1.97	1900	2.31
1883	1.49	1892	1.96	1901	2.039
1884	1.49	1893	1.74	1902	2.49
1885	1.49	1894	1.34	1903	2.63
1886	1.63	1895	1.44	1904	1.95
1887	2.01	1896	1.837	1905	2.249
1888	1.46	1897	1.663		

NUMBER OF COKE WORKS IN THE UNITED STATES.

The total number of establishments manufacturing coke in the United States at the end of each decade from 1850 to 1900, and for each year from 1901 to 1905, is shown in the following table. The numbers reported in 1850, 1860, and 1870 are for the census years, the others being for calendar years:

Number of coke establishments in the United States since 1850.

Year.	Number.	Year.	Number.
1850 (census year)	4	1901, December 31	423
1860 (census year)	21	1902, December 31	456
1870 (census year)	25	1903, December 31	500
1880, December 31	186	1904, December 31	506
1890, December 31	253	1905, December 31	519
1900, December 31	396		

The 519 establishments in 1905 included 10 with a total of 890 ovens which were not entirely completed, and consequently did not contribute to the production last year. There were also 75 plants having a total of 5,932 ovens that were idle throughout the year. These idle establishments were for the most part comparatively small plants, averaging 79 ovens each, and most of them have been idle for several years, some being practically abandoned. Deducting the idle plants, and those that were not completed before the end of the year, from the total, it is seen that there were 434 active plants during 1905, with a total of 80,742 ovens, or an average of 186 ovens to the establishment. The total production from the 434 active establishments in 1905 was 32,231,129 short tons, or an average of 74,496 tons for each establishment. In 1904 there were 424 active establishments which produced 23,661,106 tons of coke, or an average of 55,804 tons each, from which it appears that the output from each establishment in 1905 was 33.5 per cent larger than it was in 1904. In 1880, the first year for which these statistics were collected, there were 186 establishments, the average production of which was 17,948 tons. It appears therefore that the output from each establishment in 1905 was something over four times what it was in 1880.

It should be stated that the word "establishment," as used in this report, is intended to designate the number of plants or banks of ovens in existence, whether operated or idle, and whether reported from one central office or separately. All the different plants of the H. C. Frick Coke Company, for instance, are considered as separate establishments.

The following tables show the number of coke ovens in existence in each State or Territory for the five years from 1901 to 1905, and the total number completed at the end of each year since 1880:

Number of coke ovens in each State at the close of each year, 1901–1905.

State or Territory.	1901.	1902.	1903.	1904.	1905.
Alabama	7,136	7,571	8,764	9,059	9,586
Colorado	2,060	3,010	3,455	3,419	3,421
Georgia	510	492	500	500	533
Illinois	154	149	155	155	275
Indiana	54	50	36	36	36
Indian Territory	230	280	286	286	388
Kansas	98	97	91	90	91
Kentucky	461	485	499	499	495
Maryland	....	....	200	200	200
Massachusetts	400	400	400	400	400
Michigan	30	75	75	135	135
Minnesota	....	....	....	50	50
Missouri	9	8	8	8	6
Montana	328	410	555	520	555
New Jersey	....	100	100	100	100
New Mexico	126	126	126	234	258
New York	30	30	40	352	399
Ohio	419	449	440	539	573
Pennsylvania	34,906	36,609	40,239	42,165	42,608
Tennessee	2,135	2,269	2,439	2,436	2,615
Utah	204	404	504	504	504
Virginia	2,775	2,974	4,251	4,345	4,549
Washington	148	231	256	256	216
West Virginia	11,544	12,656	15,613	16,929	19,189
Wisconsin	120	120	228	308	308
Wyoming	74	74	74	74	74
Total	63,951	69,069	79,334	83,599	87,564

Number of coke ovens in the United States on December 31 of each year, 1880–1905.

Year.	Ovens.	Year.	Ovens.	Year.	Ovens.
1880	12,372	1889	34,165	1898	48,383
1881	14,119	1890	37,158	1899	49,603
1882	16,356	1891	40,057	1900	58,484
1883	18,304	1892	42,002	1901	63,951
1884	19,557	1893	44,201	1902	69,069
1885	20,116	1894	44,772	1903	79,334
1886	22,597	1895	45,565	1904	83,599
1887	26,001	1896	46,944	1905	87,564
1888	30,059	1897	47,668		

A statement of the number of ovens in course of construction at the end of each year since 1900 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, 1900–1905.

1900	5,804	1903	6,175
1901	5,205	1904	4,430
1902	8,758	1905	4,751

RANK OF COKE-PRODUCING STATES.

In the following table is shown the relative rank of the different States and Territories during the last five years. Pennsylvania has headed the list in the manufacture of coke as in the production of coal since these reports have been published. Alabama and West Virginia have been for the greater part of the time during the last twenty-five years rivals for second place, and during the last five years have occupied it alternately. Virginia and Colorado rank fourth and fifth, respectively, and Massachusetts and Tennessee are rivals for sixth place:

Rank of the States and Territories in production of coke, 1901–1905.

State or Territory.	1901.	1902.	1903.	1904.	1905.	State or Territory.	1901.	1902.	1903.	1904.	1905.
Pennsylvania	1	1	1	1	1	New York	16	16	16	11	14
West Virginia	2	3	2	3	2	New Mexico	15	18	21	17	15
Alabama	3	2	3	2	3	Minnesota	......	......	......	21	16
Virginia	4	4	4	4	4	Kentucky	9	9	12	16	17
Colorado	5	5	5	5	5	Georgia	11	11	14	15	18
Tennessee	7	6	6	7	6	Indian Territory	17	15	17	19	19
Massachusetts	6	7	7	6	7	Washington	14	17	18	18	20
Maryland	......	......	8	8	8	Montana	10	13	19	20	21
Michigan	20	14	11	10	9	Illinois	22	22	23	23	22
Ohio	8	8	10	14	10	Kansas	19	19	20	22	23
Utah	12	10	9	9	11	Wyoming	18	20	22	24	24
Wisconsin	13	12	15	12	12	Missouri	21	21	24	25	25
New Jersey	......	......	13	13	13	Indiana	......	......	25	......	......

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 1901 to 1905, 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, 1901–1905, by States and Territories.

[Short tons.]

State or Territory.	1901.	1902.	1903.	1904.	1905.
Alabama	3,849,908	4,237,491	4,483,942	3,996,578	4,409,854
Colorado[a]	1,148,901	1,695,188	1,776,974	1,376,354	2,368,365
Georgia	89,919	129,642	146,086	132,270	119,036
Illinois	....	....	....	8,131	16,821
Indian Territory	74,746	110,934	110,088	98,847	123,389
Kansas	11,629	35,827	30,503	14,525	6,504
Kentucky	204,297	265,121	247,950	140,139	154,783
Missouri	9,041	10,430	3,004	3,815	2,551
Montana	102,950	99,628	82,118	78,303	68,777
New Mexico	72,350	40,943	18,613	94,397	148,469
Ohio	162,624	219,401	211,473	165,487	396,961
Pennsylvania	21,736,467	25,017,326	23,724,207	22,432,064	31,030,345
Tennessee	739,246	1,025,864	1,001,356	718,181	862,320
Utah	(b)	(b)	(b)	(b)	(b)
Virginia	1,400,231	1,716,110	1,860,225	1,636,905	2,184,369
Washington	78,393	68,546	73,119	76,993	85,715
West Virginia	3,734,076	4,078,579	4,347,160	3,543,338	5,329,695
Maryland, Massachusetts, Michigan, Minnesota, New Jersey, New York, Wisconsin, Wyoming	793,187	852,977	1,306,707	2,015,281	2,222,723
Total	34,207,965	39,604,007	39,423,525	36,531,608	49,530,677

[a] Includes coal coked in Utah. [b] Included with Colorado.

Quantity of coal used annually in the manufacture of coke in the United States, 1880–1905.

[Short tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1880	5,237,741	1889	15,960,973	1898	25,249,570
1881	6,546,762	1890	18,005,209	1899	30,219,343
1882	7,577,646	1891	16,344,540	1900	32,113,543
1883	8,516,670	1892	18,813,337	1901	34,207,965
1884	7,951,974	1893	14,917,146	1902	39,604,007
1885	8,071,126	1894	14,348,750	1903	39,423,525
1886	10,688,972	1895	20,848,323	1904	36,531,608
1887	11,859,752	1896	18,694,422	1905	49,530,677
1888	12,945,350	1897	20,907,319		

QUANTITY AND VALUE OF COAL USED IN COKE MAKING.

The total quantity and value of the coal consumed in the manufacture of coke in 1904 and 1905, with the quantity and value of coal consumed per ton of coke produced, by States and Territories, are shown in the following tables. The quantity of coal consumed in 1905 was 49,530,677 short tons, against 36,531,608 tons in 1904. The value of the coal used in 1905 was $50,614,674, compared with $37,209,844 in 1904, there being but a shade of difference in the value as compared with the quantity. In 1904 the average value per ton of the coal used was $1.018, and in 1905 it was $1.02, a difference of only 0.2 cent. There was a marked difference in the value of the coke product, which was $46,144,941, or $1.95 per ton, in 1904, and $72,476,196, or $2.25 per ton, in 1905.

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
New Mexico	94,397	111,391	1.18	1.62	1.91
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 York, Wisconsin, Wyoming	2,015,281	4,457,523	2.21	1.39	3.07
Total	36,531,608	37,209,844	1.018	1.544	1.572

[a] Includes Utah.

Quantity and value of coal used in the manufacture of coke in the United States in 1905, 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	4,409,854	$5,295,883	$1.20	1.711	$2.053
Colorado [a]	2,368,365	2,359,540	.996	1.718	1.711
Georgia	119,036	132,269	1.11	1.686	1.871
Illinois	16,821	23,319	1.386	1.632	2.262
Indian Territory	123,389	147,475	1.19	2.252	2.680
Kansas	6,504	7,640	1.17	1.47	1.720
Kentucky	154,783	66,019	.427	1.947	.831
Missouri	2,551	1,931	.757	1.615	1.223
Montana	68,777	204,868	2.98	2.184	6.508
New Mexico	148,469	140,326	.945	1.656	1.565
Ohio	396,961	686,627	1.729	1.432	2.476
Pennsylvania	31,030,345	29,736,804	.958	1.508	1.445
Tennessee	862,320	869,488	1.01	1.842	1.86
Virginia	2,184,369	1,818,523	.832	1.457	1.212
Washington	85,715	195,978	2.286	1.613	3.687
West Virginia	5,329,695	4,090,510	.767	1.567	1.202
Maryland, Massachusetts, Michigan, Minnesota, New Jersey, New York, Wisconsin, Wyoming	2,222,723	4,837,474	2.17	1.338	2.903
Total	49,530,677	50,614,674	1.02	1.537	1.568

[a] Includes Utah.

The following table shows approximately the quantity of coal required to produce a ton of coke in 1880, 1890, 1900, and each year since 1901:

Coal required to produce a ton of coke, in tons or pounds.

Year.	Tons.	Pounds.	Year.	Tons.	Pounds.
1880	1.57	3,140	1902	1.56	3,120
1890	1.56	3,120	1903	1.56	3,120
1900	1.57	3,140	1904	1.544	3,088
1901	1.57	3,140	1905	1.537	3,074

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 quantity 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 quantity 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 five years:

Percentage yield of coal in coke, 1901–1905, by States and Territories.

State or Territory.	1901.	1902.	1903.	1904.	1905.
Alabama	55.8	60.2	60	58.6	58.4
Colorado[a]	58.4	59.2	59.3	57.3	58.2
Georgia	60.7	63.3	58.5	57.3	59.3
Illinois	....	....	....	54.6	61.3
Indian Territory	50	44.6	45	45.3	44.4
Kansas	61.4	58.3	46.5	65	68.0
Kentucky	49	47.8	46.5	45.7	51.4
Missouri	52.5	55.4	61.2	64	61.9
Montana	55.4	53.7	54.9	53	45.8
New Mexico	57.5	56.9	59.4	61.7	60.4
Ohio	66.9	66.6	68	66	69.8
Pennsylvania	66	65.9	65.9	66.2	66.3
Tennessee	54.6	54.6	54.6	52.8	54.3
Virginia	64.7	65.5	63.2	67.3	68.6
Washington	62.7	58.8	62.4	59	62
West Virginia	61.1	61.7	62.3	64.4	63.8
Maryland, Massachusetts, Michigan, New Jersey, New York, Wisconsin, Wyoming	71.1	70.2	71.3	72	74.7
Total average	63.7	64.1	64.1	64.8	65.07

[a] Average, including Utah.

Percentage yield of coal in coke, 1880–1905.

Year.	Percentage yield of coal.	Year.	Percentage yield of coal.
1880	63	1902	64.1
1890	64	1903	64.1
1900	63.9	1904	64.8
1901	63.7	1905	65.07

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 quantity 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 quantity 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 1905 14,559,369 short tons, or 29.4 per cent, of the total quantity of coal used in coke making was slack, and of this slack coal 6,363,143 short tons, or 43.7 per cent, was washed before being coked. Of the run-of-mine coal used in coke making less than 10 per cent (3,187,994 tons out of a total of 34,971,308 tons in 1905) was washed before coking.

Among the more important coke-producing States it is to be observed that in Pennsylvania only about 11 per cent of the coal used is slack, and that only 5 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 8 per cent is washed; in Alabama from 40 to 60 per cent of the coal used is slack, practically all of which is washed; in Virginia a small quantity of coal was washed in 1904, though as a usual thing the coal is used unwashed, and none of it was washed in 1905. In Colorado all of the coal coked is slack, three-fourths of which is washed. All of the coal used in New Mexico is washed slack. In Tennessee about half of the coal used is run-of-mine, 60 per cent of which is washed, and half is slack, of which nearly 90 per cent is washed.

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
New Mexico				94,397	94,397
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
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, New Mexico, New York, Wisconsin, Wyoming	1,058,272	163,616	96,620	709,159	2,027,667
Total	23,779,885	2,370,118	4,840,288	5,517,565	36,531,608

[a] Includes Utah.

Character of coal used in the manufacture of coke in 1905.

[Short tons.]

State or Territory.	Run of mine.		Slack.		Total.
	Unwashed.	Washed.	Unwashed.	Washed.	
Alabama	1,297,376	1,247,924	0	1,864,554	4,409,854
Colorado[a]	0	0	691,982	1,676,383	2,368,365
Georgia	0	28,495	0	90,541	119,036
Illinois	8,101	0	0	8,720	16,821
Indian Territory	21,891	....	49,407	52,091	123,389
Kansas	0	0	6,504	0	6,504
Kentucky	23,168	0	35,743	95,872	154,783
Missouri	726	0	1,825	0	2,551
Montana	1,463	67,314	0	0	68,777
New Mexico	0	0	0	148,469	148,469
Ohio	348,502	0	10,837	37,622	396,961
Pennsylvania	26,148,696	1,335,631	2,436,621	1,109,397	31,030,345
Tennessee	134,432	244,302	46,073	437,513	862,320
Virginia	1,096,656	0	1,087,713	0	2,184,369
Washington	0	85,715	0	0	85,715
West Virginia	1,445,099	1,950	3,577,793	304,853	5,329,695
Maryland, Massachusetts, Michigan, Minnesota, New Jersey, New York, Wisconsin, Wyoming	1,257,204	176,663	251,728	537,128	2,222,723
Total	31,783,314	3,187,994	8,196,226	6,363,143	49,530,677

[a] Includes Utah.

In the following table the statistics regarding the character of the coal for the years 1890 to 1905, inclusive, are consolidated:

Character of coal used in the manufacture of coke in the United States, 1890–1905.

[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	5,517,565	36,531,608
1905	31,783,314	3,187,994	8,196,226	6,363,143	49,530,677

The increasing proportion of washed coal for coke making, as shown in the preceding table, is striking. In 1890 only 7 per cent of the total amount of coal used was washed. In 1895 the percentage of washed coal was a little over 10 per cent; in 1900 it was 16.6 per cent; and in 1905 it was 19 per cent.

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 increased from 1,956 in 1903, to 2,910 in 1904, and 3,159 in 1905, while the production of by-product coke has increased from 1,882,394 short tons in 1903, to 2,608,229 short tons in 1904, and to 3,462,348 tons in 1905. The increase in 1905 over 1904 was 854,119 short tons, or 32.7 per cent. There were under construction at the close of 1905, 417 new by-product ovens. This is the smallest number of this type of ovens reported under construction in any year since 1899.

The average production of the 3,159 by-product ovens in operation during 1905 was 1,158.8 short tons of coke. In 1904 the average output per oven was 896 tons, and in 1903 it was 962.4 tons. The average production from the beehive ovens in blast was 365.8 tons in 1905, 283.5 tons in 1904, and 310.3 tons in 1903.

In the 3,462,348 tons of by-product coke produced in 1905 a total of 4,628,891 short tons of coal were used, indicating a yield of 74.8 per cent of coal in coke. In 1903 the percentage yield was 73. These are much larger yields than can be obtained in beehive ovens, as a part of the fixed carbon is unavoidably burned in beehive-oven practice. As previously shown, the average yield of coal in coke for the United States in 1905 (including the output of by-product recovery ovens) was 65 per cent, and this is probably higher than the results actually obtained.

Notwithstanding the evident economies effected by the making of coke in retort ovens, these economies, consisting not only of a higher yield of coal in coke, but in the recovery of the valuable by-products of gas, tar, and ammonia, manufacturers in the United States have been slow to change from the better known but wasteful beehive practice. It is now thirteen years since the first plant established in this country was erected at Syracuse, N. Y., and while since that time there has been a steady development, the increase in the number of ovens built and building in the last two years has been somewhat slower than it was during the preceding four or five years. On December 31, 1903, there were 1,335 ovens in course of construction and 1,956 in operation. Of the ovens building at the close of 1903, 954 were completed in 1904, making the total for that year 2,910. There was a decided decrease in the number of ovens building at the close of 1904, however, the number reported as under construction being 832. There were 249 more retort ovens in operation in 1905 than in 1904, but the number building at the close of the year was only 417, just about half the number building at the close of 1904, and less than one-third of the number building at the close of 1903.

The first plant at Syracuse, N. Y., which was completed in 1893, consisted of 12 Semet-Solvay ovens, and the production in that year amounted to 12,850 tons. This plant has since been increased to 40 ovens. The first plant of Otto-Hoffmann ovens was constructed at Johnstown, Pa., and consisted of 60 ovens, operated in connection with the (now) Cambria Steel Company. The main difference in these two types of ovens lies in the arrangement of the flues for the combustion of the gases used in heating them. In one the flues are vertical and in the other they are horizontal. Most of the by-product ovens constructed in this country have been of one of these two designs. At the close of 1905 there were 1,055 Semet-Solvay ovens in operation, with 240 building; of the Otto-Hoffmann type there were 1,827 completed and 177 building. In addition to these there were 221 Rothberg ovens in operation during the year, but no new ones of this type were under construction. The plant of 56 Newton-Chambers ovens constructed at Pocahontas, Va., has not been in operation for several years.

The distribution of the building and completed by-product ovens in 1905 was as follows:

Semet-Solvay ovens: Syracuse, N. Y., 40; Dunbar, Pa., 110; Chester, Pa., 40; Lebanon, Pa., 90; Sharon, Pa., 25; Ensley, Ala., 240; Tuscaloosa, Ala., 40; Delray, Mich., 120; Chicago, Ill., 120; Milwaukee, Wis., 80 completed and 80 building; Benwood, W. Va., 120; Steelton, Pa., 160 (building).

Otto-Hoffmann ovens: Johnstown, Pa., 260 completed and 112 building; Otto, Pa., 120; Lebanon, Pa., 232; Sharon, Pa., 212 (Schniewind modified); Sparrows Point, Md., 200; Everett, Mass., 400; Wyandotte, Mich., 15 completed and 15 building; Duluth, Minn., 50; Camden, N. J., 100 completed and 50 building; Buffalo, N. Y., 188; Waterloo, N. Y., 30; Hamilton, Ohio, 50.

Rothberg ovens: Buffalo, N. Y., 141; Cleveland, Ohio, 80.

The principal development in retort-oven practice in 1905 was in the practical demonstration of the possibility of long-distance transmission of the gas produced. The industry has also advanced in the number of ovens in regular operation, and the field for the disposal of its products has enlarged.

The well-known hesitancy on the part of blast-furnace managers to commit themselves to an unfamiliar fuel, the physical appearance of which is somewhat against it, is gradually yielding to the effects of successful experience with by-product coke. That this is the case is indicated by the recent addition of 112 United-Otto ovens to the existing plant of the Cambria Steel Company at Johnstown, Pa., this being the fourth installment, and making the total number of ovens at that place 372.

Aside from the extended use of by-product coke in blast furnaces and foundries the use of crushed and sized coke for domestic and industrial purposes as a substitute for anthracite and bituminous coal has increased notably. The plant at Camden, N. J., has restricted its output for foundry purposes and now relies mainly upon the domestic trade in Camden, Philadelphia, and vicinity, which has been such as to justify an increase in oven capacity of over 50 per cent. The plant at Hamilton, Ohio, has added to its equipment for crushing domestic coke, and a larger proportion of its output than ever before now goes to this field. The plant at Glassport, Pa., has also found that the demand for domestic coke was sufficient to justify the installation of improved crushing equipment. At Everett, Mass., practically the pioneer plant in this direction, the coke product is now easily and regularly disposed of, it being about equally divided between domestic or industrial uses and fuel for locomotives in suburban traffic.

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, 1893–1905.

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	2,910	832	2,608,229
1905	[a] 3,159	[b] 417	3,462,348

[a] Includes 1,055 Semet-Solvay, 1,615 Otto-Hoffmann, 212 Schniewind, 221 Rothberg, and 56 Newton-Chambers.
[b] Includes 240 Semet-Solvay and 177 Otto-Hoffmann.

In the following table is shown the record of by-product coke ovens, by States, at the close of 1901–1905:

Record of by-product ovens, by States.

State.	Ovens December 31, 1901.		Ovens December 31, 1902.		Ovens December 31, 1903.		Ovens December 31, 1904.		Ovens December 31, 1905.	
	Completed.	Building.	Completed.	Building.	Completed.	Building.	Completed.	Building.	Completed.	Building.
Alabama	120	120	240	40	240	40	240	40	280	0
Illinois	0	0	0	0	0	120	0	120	120	0
Maryland	0	200	0	200	200	0	200	0	200	0
Massachusetts	400	0	400	0	400	0	400	0	400	0
Michigan	30	45	75	60	75	60	135	0	135	15
Minnesota	0	0	0	0	0	50	50	0	50	0
New Jersey	0	100	100	0	100	0	100	0	100	50
New York	30	564	30	574	40	500	352	658	399	0
Ohio	50	0	50	60	50	66	116	14	130	0
Pennsylvania	355	504	592	412	675	419	1,061	0	1,089	272
Virginia	60	0	56	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	80	80	0	80	80
Total	1,165	1,533	1,663	1,346	1,956	1,335	2,910	832	3,159	417

Kind and location of by-product coke ovens built and building in the United States at the close of 1905.

State.	Semet-Solvay.		Otto-Hoffman and Schniewind.		Rothberg.		Total.	
	Built.	Building.	Built.	Building.	Built.	Building.	Built.	Building.
Alabama	280	....	....	....	....	....	280	0
Illinois	120	....	....	....	....	....	120	0
Maryland	....	....	200	....	....	....	200	0
Massachusetts	....	....	400	....	....	....	400	0
Michigan	120	....	15	15	....	....	135	15
Minnesota	....	....	50	....	....	....	50	0
New Jersey	....	....	100	50	....	....	100	50
New York	70	....	188	....	141	....	399	0
Ohio	....	....	50	....	80	....	130	0
Pennsylvania	265	160	824	112	....	....	1,089	272
Virginia	....	....	....	....	....	....	56	0
West Virginia	120	....	....	....	....	....	120	0
Wisconsin	80	80	....	....	....	....	80	80
Total	1,055	240	1,827	177	221	....	3,159	417

IMPORTS AND EXPORTS.

The following table gives the quantity and value of coke imported and entered for consumption in the United States from 1900 to 1905, 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, 1900–1905.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1900	115,557	$371,341	1903	142,776	$437,625
1901	81,456	266,075	1904	180,855	648,521
1902	140,489	423,775	1905	203,142	796,545

The quantity and value of coke exported from the United States have increased each year since 1900, as shown in the following table:

Coke exported from the United States since 1900.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1900	422,239	$1,358,968	1903	466,351	$2,091,875
1901	430,450	1,561,898	1904	585,860	2,311,401
1902	439,590	1,785,188	1905	660,940	....

PRODUCTION OF COKE BY STATES.

ALABAMA.

For the last twenty-five years, or since the statistics of the production of coke have been compiled by the Geological Survey, Alabama has contested with West Virginia for second place in the rank of coke-producing States. During the last five years each State has held it alternately, the honor falling to West Virginia in 1905.

The production of coke in Alabama in 1905 amounted to 2,576,986 short tons, valued at $7,646,957, against 2,340,219 tons, worth $5,716,413 in 1904, indicating an increase of 236,767 short tons, or 10.12 per cent in quantity and of $1,930,544, or 33.8 per cent in value. The percentage of increase in production in Alabama in 1905 over 1904 was less than that made in any of the other important coke-producing States, but this was compensated for in the much larger increase in value. The quantity of coke made in 1905 was less by 116,511 tons than the output in 1903, when the production amounted to 2,693,497 tons, but the value of the product in 1905 exceeded that of 1903 by $24,429. The average price in 1905 was $2.97 per ton, the highest point reached in twenty years, with the exception of 1902, when the high point of $3.25 was reached.

There were 42 coke-making establishments in Alabama in 1905, the same number as in 1904, having a total of 9,586 ovens, against 9,059 the preceding year. The number of ovens building at the close of 1905 was 150, as compared with 440 in 1904. The 42 establishments in 1905 included 8 having a total of 1,450 ovens that were idle during the year. Two of these idle plants were new, the ovens being completed, but not put in blast. One of the new plants was the bank of Semet-Solvay retort ovens at Tuscaloosa, reported in 1904 as being under construction.

The production of coke in Alabama in 1880, 1890, 1900, and from 1901 to 1905 has been as follows:

Statistics of the manufacture of coke in Alabama, 1880–1905.

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	316	100	106,283	60,781	$183,063	$3.01	57
1890	20	4,805	371	1,809,964	1,072,942	2,589,447	2.41	59
1900	30	6,529	690	3,582,547	2,110,837	5,629,423	2.667	58.9
1901	31	7,136	535	3,849,908	2,148,911	6,062,616	2.82	55.8
1902	37	7,571	1,334	4,237,491	2,552,246	8,300,838	3.25	60.2
1903	39	8,764	381	4,483,942	2,693,497	7,622,528	2.83	60
1904	42	9,059	440	3,996,578	2,340,219	5,716,413	2.443	58.6
1905	42	a 9,586	150	4,409,854	2,576,986	7,646,957	2.967	58.4

a Includes 280 Semet-Solvay ovens.

The character of the coal used in the manufacture of coke in Alabama in 1890, 1895, and since 1900 is shown in the following table:

Character of coal used in the manufacture of coke in Alabama, 1890–1905.

[Short tons.]

Year.	Run of mines.		Slack.		Total.
	Unwashed.	Washed.	Unwashed.	Washed.	
1890	1,480,669	0	206,106	123,189	1,809,964
1895	1,208,020	0	32,068	1,219,377	2,459,465
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
1905	1,297,376	1,247,924	....	1,864,554	4,409,854

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 1905 amounted to 1,378,824 short tons against 789,060 tons in 1904, an increase of 589,764 tons, or nearly 75 per cent. Coke production in Colorado during 1904 was put back by labor troubles, which affected not only the coal mines and coke ovens but the smelting industry as well. The production of coke declined over 25 per cent as compared with 1903. Unhampered by such conditions in 1905, and stimulated by an active demand, the production of coke surpassed all previous records and exceeded by 325,000 tons, or over 30 per cent, the previous maximum output of 1903.

There were 17 establishments with a total of 3,925 ovens in the two States in 1905. Two of the establishments, having together 37 ovens, were idle throughout the year, making a total of 3,888 active ovens, all of which are of the beehive type. The average production per oven in 1905 was 355 tons against 202 tons in 1904.

All of the coal used in the manufacture of coke in Colorado and Utah in 1905 was slack coal, and about 70 per cent of this was washed before being charged into the ovens.

The statistics of the manufacture of coke in Colorado and Utah in 1880, 1890, 1900, and from 1901 to 1905 are shown in the following table:

Statistics of the manufacture of coke in Colorado and Utah, 1880–1905.

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
1890	8	916	30	407,023	245,756	959,246	3.90	60
1900	13	1,488	0	997,861	618,755	1,746,732	2.82	62
1901	15	2,060	1,203	1,148,901	671,303	1,626,279	2.42	58.4
1902	15	3,010	363	1,695,188	1,003,393	2,754,341	2.74	59.2
1903	16	3,455	0	1,776,974	1,053,840	3,089,783	2.93	59.3
1904	15	3,419	0	1,376,354	789,060	2,590,251	3.28	57.3
1905	15	3,421	0	2,368,365	1,378,824	4,157,517	3.02	58.2

The character of the coal used in the manufacture ot coke in Colorado and Utah in 1890, 1895, 1900, and from 1901 to 1905 is shown in the following table:

Character of coal used in the manufacture of coke in Colorado and Utah, 1890–1905.

[Short tons.]

Year.	Run of mine.		Slack.		Total.
	Unwashed.	Washed.	Unwashed.	Washed.	
1890	36,058	0	395,023	0	431,081
1895	119,868	0	453,597	7,119	580,584
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
1905	0	0	691,982	1,676,383	2,368,365

GEORGIA.

Dade County, in the extreme northwestern corner of Georgia, contains a small area of the Walden Ridge, Tennessee coal basin, and a portion of the adjoining county of Walker is underlain by an extension of the Lookout Mountain beds of Alabama. Coal mining on quite an extensive scale is carried on in both counties, and a good grade of coke is made from the slack coal produced in mining. The iron furnaces in and near Chattanooga, Tenn., supply the principal market for the coke. Most of the coal coked is washed before being charged into the ovens.

Georgia is one of the four States whose coke production in 1905 was less than that in 1904. The output in 1905 amounted to 70,593 short tons, against 75,812 tons in 1904, a decrease of 5,219 tons, or 6.88 per cent. The value, however, increased from $212,697 to $224,260, the average price advancing from $2.81 to $3.18 per ton. There are two establishments in the State, both of which produced coke in 1905. The number of ovens increased from 500 in 1904 to 533 in 1905.

The statistics of coke production in Georgia in 1880, 1890, 1900, and from 1901 to 1905 have been as follows:

Statistics of the manufacture of coke in Georgia, 1880–1905.

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
1890	1	300	0	170,388	102,233	150,995	1.48	60
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
1905	2	533	0	119,036	70,593	224,260	3.18	59.3

ILLINOIS.

During 1905 a bank of 120 Semet-Solvay ovens was completed at South Chicago and put in blast in October, using coal drawn from the fields of Fayette County, W. Va. There are four other establishments in the State, but only one of these, the Gallatin Coal and Coke Company, at Equality, made coke in 1905. The plant at Gallatin used washed slack and the Semet-Solvay ovens at South Chicago used run of mine. The total production of the two plants in 1905 was 10,307 short tons, valued at $27,681. With the South Chicago ovens in full blast the coke production in Illinois for 1906 should exceed 100,000 tons.

INDIAN TERRITORY.

There are five coke-making establishments in the Indian Territory, four of which made coke in 1905. The 100 ovens at Howe were not in operation. The production increased from 44,808 short tons in 1904 to 54,781 tons in 1905, a gain of 9,973 tons, or 22.25 per cent. The value decreased from $209,165 to $199,424, and the average price per ton declined from $4.67 to $3.64.

All of the ovens in the Indian Territory are of the standard beehive type and were constructed for the purpose of utilizing the slack coal produced in mining and for which there is little or no demand. The coal used for coke making in 1905 included 21,891 short tons of unwashed run of mine. Something over half of the slack coal used was washed before coking.

The statistics of the manufacture of coke in the Indian Territory in 1880, 1890, 1900, and from 1901 to 1905 are as follows:

Statistics of the manufacture of coke in the Indian Territory, 1880–1905.

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
1890	1	80	0	13,278	6,639	21,577	3.25	50
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
1905	5	388	50	123,389	54,781	199,424	3.64	44.4

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, 1890–1905.

[Short tons.]

Year.	Run of mine.		Slack.		Total.
	Unwashed.	Washed.	Unwashed.	Washed.	
1890	0	0	0	13,278	13,278
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
1905	21,891	0	49,407	52,091	123,389

KANSAS.

The coking industry of 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 zinc works, the plant at Cokedale not having been in blast during the last two years. Of the 6 establishments in the State only 3, with a total of 28 ovens, were in operation. The production decreased from 9,460 short tons, valued at $23,485, in 1904, to 4,425 tons, valued at $13,818, in 1905.

The coal used is Pittsburg (Kansas) slack, all of which in 1905 was unwashed. The largest production ever obtained in the State was in 1902, when the output amounted to 20,902 tons.

The statistics of the manufacture of coke in Kansas in 1880, 1890, 1900, and from 1901 to 1905, are as follows:

Statistics of the manufacture of coke in Kansas, 1880–1905.

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	2	6	0	4,800	3,070	$6,000	$1.95	64
1890	7	68	0	21,809	12,311	29,116	2.37	56
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	91	0	14,525	9,460	23,485	2.48	65
1905	6	91	0	6,504	4,425	13,818	3.12	68

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.

There are 6 coke-making establishments in Kentucky, 2 of which were idle in 1905. The production from the 4 active plants amounted in 1905 to 79,487 short tons, valued at $159,659, against a total production in 1904 of 64,112 tons, valued at $138,226. One establishment at Ashland used unwashed run-of-mine coal. All of the others used slack, most of which was washed.

Developments which have been in progress for some time in eastern Kentucky, and which are following the construction of a branch line of the Chesapeake and Ohio Railroad into the coal fields of Letcher and Pike counties, indicate that an extensive coking industry is to be established in that section.

The statistics of the manufacture of coke in Kentucky in 1880, 1890, 1900, and from 1901 to 1905, are as follows:

Statistics of the manufacture of coke in Kentucky, 1880–1905.

Year.	Establishments.	Ovens.		Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
		Built.	Building.					
				Short tons.	*Short tons.*			*Per cent.*
1880	5	45	0	7,206	4,250	$12,250	$2.88	59
1890	9	175	103	24,372	12,343	22,191	1.80	51
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
1905	6	495	0	154,783	79,487	159,659	2.008	51.4

MISSOURI.

The manufacture of coke in Missouri is confined to 2 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 in 1887, when coking began in this State, in 1890, 1900, and from 1901 to 1905, are as follows:

Statistics of the manufacture of coke in Missouri, 1887–1905.

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
1890	3	10	0	9,491	6,136	9,240	1.51	65
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
1905	2	6	0	2,551	1,580	4,072	2.577	61.9

MONTANA.

There are 4 plants of coke ovens in Montana, 2 of which were active and 2 idle in 1905. In 1904 coke was produced at 3 establishments. As the result of an additional idle plant in 1905, the production of coke decreased from 41,497 tons to 31,482 tons. Coke production in Montana has, in fact, decreased each year since 1901.

All of the coal used for coke making in Montana is run of mine, practically all of which is washed before being charged into the ovens.

The statistics of the manufacture of coke in Montana in 1884, when production was first reported, in 1890, 1900, and from 1901 to 1905, are as follows:

Statistics of the manufacture of coke in Montana, 1884–1905.

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.
1884	3	5	12	165	75	$900	$12.00	46
1890	2	140	0	32,148	14,427	125,655	8.71	45
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
1905	4	555	100	68,777	31,482	211,351	6.71	45.8

NEW MEXICO.

There are 3 coke-making plants in New Mexico, 2 of which made coke in 1905. The production last year amounted to 89,638 short tons, an increase of 31,379 tons over 1904, but a decrease as compared with 1903 of 20,412 tons. All of the coal used is washed slack.

The statistics of production in 1882, 1890, 1900, and from 1901 to 1905, have been as follows:

Statistics of the manufacture of coke in New Mexico, 1882–1905.

Year.	Establishments.	Ovens. Built.	Ovens. Building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	Short tons.			Per cent.
1882	2	0	12	1,500	1,000	$6,000	$6.00	66
1890	2	70	0	3,980	2,050	10,025	4.89	51.5
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	3	234	0	94,397	58,259	171,976	2.95	61.7
1905	3	258	498	148,469	89,638	253,229	2.825	60.4

OHIO.

Although Ohio ranks fourth in importance among the coal-producing States, it has not developed much prominence as a coke producer. This is, in part, due to the fact that much of the coal mined in the State makes an excellent fuel in its raw state and also to the proximity of the higher-grade coking coals of Pennsylvania and West Virginia. The operations of the Rothberg by-product recovery plant at Cleveland, which was in full blast in 1905, and the Otto-Hoffmann plant, at Cincinnati, together with an exceptionally large production of beehive coke at Leetonia, did, however, bring the total production for the State last year up to considerable importance. The coke product of Ohio in 1905 was more than two and one-half times that of 1904, amouuting to 277,130 short tons, against 109,284 tons the preceding year, while the value increased nearly 190 per cent, from $337,606 to $970,897.

Of the 8 establishments in the State, 2, with a total of 170 ovens, were idle throughout the year. The 403 active ovens produced an average of 688 tons each.

The statistics of the production of coke in Ohio in 1880, 1890, 1900, and from 1901 to 1905, are given in the following table:

Statistics of the manufacture of coke in Ohio, 1880–1905.

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
1890	13	443	1	126,921	74,633	218,090	2.92	59
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
1905	8	[c]573	0	396,961	277,130	970,897	3.50	69.8

[a] Rothberg ovens.
[b] Includes 50 Otto-Hoffmann and 66 Rothberg ovens.
[c] Includes 50 Otto-Hoffmann and 80 Rothberg ovens.

The character of the coal used in the manufacture of coke in Ohio in 1890, 1895, 1900, and from 1901 to 1905 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
1895	28,053	0	10,868	13,000	51,921
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
1905	348,502	0	10,837	37,622	396,961

PENNSYLVANIA.

Pennsylvania in coke production, as in the mining of coal, stands preeminently at the head, having for more than a quarter of a century contributed more than 50 per cent of the total coke product of the United States. Of the coke production of the State from 55 to 60 per cent is made in the famous Connellsville district of Fayette and Westmoreland counties, and if to the production of the Connellsville district is added that of the Lower Connellsville, or "Klondike," and the Upper Connellsville or Latrobe district, 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 United States.

The coke production of Pennsylvania in 1905 amounted to 20,573,736 short tons out of a total for the United States of 32,231,129 short tons. In 1904 Pennsylvania produced 14,861,064 short tons out of a total of 23,621,520, and in 1903 this State produced 15,650,932 short tons out of a total of 25,274,281 tons. Out of these totals the Connellsville district produced, in 1905, 11,365,077 tons, in 1904, 8,883,220 tons, and in 1903, 9,102,391 tons. Adding the production of the Lower and Upper Connellsville districts, the entire region produced, in 1905, 15,992,331 tons, in 1904, 12,161,216 tons, and in 1903, 12,215,821 tons.

The coke production of Pennsylvania in 1905, as was the case generally throughout the country, was the largest ever obtained. Compared with 1904 the output last year shows an increase of 5,712,672 tons, or 38.44 per cent, while compared with 1902, the year of previous maximum production, the record for 1905 shows a gain of 4,075,826 tons, or nearly 25 per cent. Except for a period of summer dullness which lasted from about the middle of May to the middle of July, coke was in active demand, with prices considerably above the normal average, from January 1 to December 31. Car supply was also generally good, and comparatively little cause for complaint was experienced in this particular. The year was, in fact, the most satisfactory one from the producers' standpoint in the history of the trade.

The increased production in 1905 was distributed among all the coking districts, and some of the smaller ones, which felt most heavily the depressing effects of the unfavorable conditions in 1904, were proportionately benefited by the unwonted activity in 1905. The Irwin district, whose production fell off from 133,290 tons in 1903 to less than 10,000 tons in 1904, increased to 164,601 tons in 1905. The Clearfield-Center district, which decreased from 178,276 tons in 1903 to 35,931 tons in 1904, recovered to 119,651 tons in 1905, and the Upper Connellsville district, which fell off over 50 per cent, from 784,132 tons in 1903 to 390,540 tons in 1904, recovered to 755,946 tons in 1905. The Lower Connellsville district, which was the only one not exhibiting a decrease in 1904, and which has increased its production each year since it was opened up in 1900, added nearly a million tons in 1905 to the record made in 1904. The increase in the Connellsville district proper was nearly 2,500,000 tons.

The total value of the coke product of Pennsylvania in 1905 was $42,253,178 against $25,027,462 in 1904, a gain of $17,225,716, or 68.8 per cent, as compared with an increase of 38.44 per cent in tonnage. Compared with 1903, when the highest values ever recorded in the history of coke-making were obtained, the value of the product in 1905 shows an increase of $3,284,077, or 8.4 per cent. The average price per ton for all coke made in Pennsylvania in 1905 was $2.05, a figure exceeded only three times in twenty-five years, and two of these were the abnormal years—1902 and 1903.

The total quantity of coal used in the manufacture of coke in Pennsylvania in 1905 was 31,030,345 short tons, valued at $29,736,804, against 22,432,064 short tons, worth $21,459,256, in 1904. The difference between the value of the coal and of the coke made from it in 1905 was $12,516,374, or 42 per cent, while in 1904 the difference was $3,568,206, or 16.6 per cent. In 1903, when values were abnormally advanced by the fuel famine caused by the anthracite strike of the preceding year, the difference between the values of the coal and coke was $14,592,053, or nearly 60 per cent.

The total number of coke-making establishments in Pennsylvania increased from 217 in 1904 to 226 in 1905, a gain of 9, and the number of completed ovens increased from 42,165 in 1904 to 42,608 in 1905, a gain of 443. There were 2,384 ovens building at the close of 1905 as compared with 1,621 at the end of 1904. The completed ovens in 1905 included 1,089 by-product recovery ovens, of which 265 were of the Semet-Solvay and 824 of the Otto-Hoffmann type. The ovens building at the close of 1905 included 160 Semet-Solvay and 112 Otto-Hoffmann.

During 1905 the H. C. Frick Coke Company increased its holdings of coke properties by the purchase of the mines and ovens of the Hecla Coke Company, located in Mount Pleasant Township, Westmoreland County. The property acquired consisted of 1,025 acres of coal land and 1,072 ovens. This gives the Frick Company a total of over 16,500 ovens out of 24,718 in the Connellsville and Lower Connellsville districts.

The statistics of the production of coke in Pennsylvania for the years 1880, 1890, 1900, and from 1901 to 1905 are shown in the following table:

Statistics of the manufacture of coke in Pennsylvania, 1880–1905.

Year.	Establishments.	Ovens. Built.	Ovens. Building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	124	9,501	836	4,347,558	2,821,384	$5,255,040	$1.86	65
1890	106	23,430	74	13,046,143	8,560,245	16,333,674	1.91	65.6
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
1905	226	42,357	2,384	31,030,345	20,573,736	42,253,178	2.054	66.3

The character of the coal used in the manufacture of coke in Pennsylvania in 1890, 1895, 1900, and from 1901 to 1905 is shown in the following table:

Character of coal used in the manufacture of coke in Pennsylvania since 1890.

[Short tons.]

Year.	Run of mine. Unwashed.	Run of mine. Washed.	Slack. Unwashed.	Slack. Washed.	Total.
1890	11,788,625	303,591	630,195	323,732	13,046,143
1895	13,618,376	34,728	440,869	117,594	14,211,567
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
1905	26,148,696	1,335,631	2,436,621	1,109,397	31,030,345

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 Semet-Solvay ovens at Chester, Steelton, and Lebanon, and the Otto-Hoffmann ovens at Lebanon, are in what has been designated as the Lebanon-Schuylkill district, the production of which has been combined with the Broadtop district.

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 1904 and 1905, are presented in the following tables:

Coke production in Pennsylvania in 1904, by districts.

District.	Establishments.	Ovens.		Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke per ton.	Yield of coal in coke.
		Built.	Building.					
				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-Hoffmann 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-Hoffmann ovens.
[f] Includes production of ovens in Allegheny Valley district.
[g] Includes 332 Otto-Hoffmann and 25 Semet-Solvay ovens.

Coke production in Pennsylvania in 1905, by districts.

District.	Establishments.	Ovens.		Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke per ton.	Yield of coal in coke.
		Built.	Building.					
				Short tons.	*Short tons.*			*Per cent.*
Allegheny Mountain	17	[a]2,245	[b]142	1,406,540	967,042	$2,421,799	$2.50	68.7
Allegheny Valley[c]	2	53	0	....	....	....	....	....
Broadtop[d]	5	614	0	687,954	483,198	1,544,966	3.197	70.2
Clearfield-Center	8	648	0	182,659	119,651	273,028	2.28	65.5
Connellsville	100	[e]22,033	200	16,980,341	11,365,077	22,315,361	1.963	66.9
Greensburg	7	1,328	100	908,003	551,233	1,155,958	2.096	60.7
Irwin	5	680	27	258,039	164,601	325,746	1.98	63.8
Lebanon and Schuylkill	4	[f]362	160	....	....	....	....	....
Lower Connellsville	45	7,484	1,145	5,666,812	3,871,310	7,532,382	1.945	68.3
Pittsburg[g]	6	[h]2,173	380	2,317,159	1,463,774	3,599,436	2.459	63.2
Reynoldsville-Walston	8	2,303	200	1,463,680	831,904	1,638,934	1.97	56.8
Upper Connellsville	19	2,685	30	1,159,158	755,946	1,445,568	1.91	65.2
Total	226	42,608	2,384	31,030,345	20,573,736	42,253,178	2.054	66.3

[a] Includes 260 Otto-Hoffmann ovens.
[b] Includes 112 Otto-Hoffmann ovens.
[c] Production included in Pittsburg district.
[d] Includes production in Lebanon and Schuylkill valleys.
[e] Includes 110 Semet-Solvay ovens.
[f] Includes 130 Semet-Solvay and 232 Otto-Hoffmann ovens.
[g] Includes production of ovens in Allegheny Valley district.
[h] Includes 332 Otto-Hoffmann 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-Hoffmann 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, and 112 more were under construction at the close of 1905. The production in 1905 was the largest in the history of the district, amounting to 967,042 short tons, against 551,570 short tons in 1904, and 739,263 tons in 1903. Of the 2,245 ovens in the district in 1905, 200 were idle throughout the year.

The statistics of the manufacture of coke in the Allegheny Mountain district in 1880, 1890, 1900, and from 1901 to 1905 are as follows:

Statistics of the manufacture of coke in the Allegheny Mountain district of Pennsylvania, 1880–1905.

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
1890	16	1,171	0	633,974	402,514	730,048	1.81	63.5
1900	14	1,341	0	876,440	557,184	1,260,441	2.26	63.6
1901	16	1,378	0	864,133	548,076	1,112,682	2.03	63.4
1902	16	1,563	380	965,412	644,053	1,782,660	2.768	66.7
1903	16	[a]2,047	[b]100	1,116,345	739,263	2,139,569	2.89	66.2
1904	17	[c]2,153	100	785,105	551,570	1,152,101	2.09	70.3
1905	17	[c]2,245	[d]142	1,406,540	967,042	2,421,799	2.50	68.7

[a] Includes 160 Otto-Hoffmann ovens.
[b] Otto-Hoffmann ovens.
[c] Includes 260 Otto-Hoffmann ovens.
[d] Includes 112 Otto-Hoffmann 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 and 1905. The production of the Semet-Solvay and Otto-Hoffmann ovens at Lebanon, in the eastern part of the State, has been added to this district. The Semet-Solvay ovens at Chester were not in operation in 1905. The production of the Broadtop district and of the ovens at Lebanon amounted in 1905 to 483,198 short tons, against 237,639 tons in 1904, an increase of more than 100 per cent.

The statistics of the manufacture of coke in the Boadtop district in 1880, 1890, 1900, and from 1901 to 1905, are shown in the following table:

Statistics of the manufacture of coke in the Broadtop district, Pennsylvania, 1880–1905.

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
1890	5	482	16	247,823	157,208	314,416	2.00	63
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
1905 *b*	5	614	0	687,954	483,198	1,544,966	3.197	70.2

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. One hundred and eighty ovens in this district were abandoned in 1905, reducing the number from 828 to 648, and of these 180 were idle in 1905. The production, which fell off from 178,276 tons in 1903 to 35,931 tons in 1904, increased again to 119,651 tons in 1905.

The statistics of production in the district for the years 1880, 1890, 1900, and from 1901 to 1905, have been as follows:

Statistics of the manufacture of coke in the Clearfield-Center-Elk district, Pennsylvania, 1880–1905.

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
1890	7	701	0	331,104	212,286	391,957	1.85	64
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
1905	8	648	0	182,659	119,651	273,028	2.28	65.5

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 three 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 22,033 ovens in this district were, at the close of 1905, 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 1905 amounted to 11,365,077 short tons, valued at $22,315,361, against 8,883,220 tons, valued at $13,990,329 in 1904, indicating an increase of 2,481,857 tons, or 28 per cent in quantity, and of $8,325,032, or 60 per cent in value. The average price per ton advanced from $1.58 to $1.96.

Although there were 22,695 completed ovens in the district in 1904 and 1,014 building at the end of the year, the total number reported in 1905 was only 22,033, indicating that there were over 1,700 abandoned last year. Counting the different banks of ovens in the district as separate plants, there were 100 establishments in 1905, a decrease of 1 from 1904. All of the establishments produced coke in 1905.

One of the most satisfactory features connected with the coke trade of the Connellsville region in 1905, aside from the large production and high prices, was the excellent service rendered by the transportation interests. There was little complaint on account of car supply, and the congested condition of traffic which greatly hampered business in 1902 and 1903 was conspicuous for its absence last year. It was altogether a red-letter year in the Connellsville coke trade.

It will be observed in the following table that the yield of coal in coke in 1904 and 1905 is shown to have been 67.4 and 66.9, respectively. 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 in 1880, 1890, 1900, and from 1901 to 1905:

Statistics of the manufacture of coke in the Connellsville region, Pennsylvania, 1880–1905.

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	67	7,211	731	3,367,856	2,205,946	$3,948,643	$1.79	65.5
1890	28	15,865	30	9,748,449	6,464,156	11,537,370	1.94	66.3
1900	98	[a]20,981	686	14,946,659	10,020,907	22,383,432	2.23	67
1901	96	[a]21,586	243	15,266,722	10,235,943	19,172,697	1.873	67
1902	97	[a]21,659	374	15,538,701	10,418,366	23,785,433	2.283	67.05
1903	99	[b]22,563	[c]130	13,498,859	9,102,391	20,707,442	2.27	67.4
1904	101	[d]22,695	1,044	13,185,690	8,883,220	13,990,329	1.575	67.4
1905	100	[d]22,033	200	16,980,341	11,365,077	22,315,361	1.963	66.9

[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 1904 and 1905, by months, in cars and tons, with the average number of cars shipped each working day in the month. These figures, which include coke made in the upper and lower Connellsville districts, are considerably larger than the production reported to the Geological Survey.

Shipments of coke from the Connellsville region in 1904 and 1905, by months.

Month.	1904.			1905.		
	Cars.	Daily average.	Tons.	Cars.	Daily average.	Tons.
January	30,077	1,157	718,382	49,352	1,592	1,283,152
February	35,319	1,413	845,428	51,928	1,856	1,350,128
March	37,804	1,400	1,062,192	57,606	1,858	1,497,756
April	50,602	1,946	1,118,043	70,904	2,367	1,843,502
May	47,152	1,813	1,146,907	55,829	1,801	1,451,554
June	38,052	1,464	945,520	52,095	1,736	1,354,470
July	36,414	1,400	887,402	62,423	2,014	1,622,998
August	40,301	1,493	975,724	51,077	1,648	1,328,002
September	47,574	1,830	1,153,471	66,413	2,214	1,726,734
October	47,214	1,816	1,148,089	55,009	1,774	1,430,238
November	49,921	1,920	1,207,131	57,267	1,909	1,488,942
December	50,329	1,864	1,219,174	58,425	1,885	1,519,050
Total	510,759	1,623	12,427,463	688,328	1,886	17,896,526

The monthly shipments of coke from this region in the years 1900 to 1905, as reported by the Courier, are given in the following table:

Monthly shipments of coke from the Connellsville region in the years 1900–1905.

[Short tons.]

Month.	1900.	1901.	1902.	1903.	1904.	1905.
January	1,001,882	989,367	1,173,860	1,134,272	718,382	1,283,152
February	910,729	939,756	971,048	958,981	845,428	1,350,128
March	1,044,588	1,150,734	1,133,978	1,274,863	1,062,192	1,497,756
April	982,551	1,070,708	1,219,928	1,346,053	1,118,043	1,843,502
May	934,186	1,084,458	1,300,648	1,288,550	1,146,907	1,451,554
June	872,316	1,075,000	1,234,596	1,379,257	945,520	1,354,470
July	732,981	1,046,996	1,271,045	1,327,239	887,402	1,622,998
August	698,065	1,099,417	1,238,260	1,211,826	975,724	1,328,002
September	673,336	1,011,439	1,246,095	1,239,265	1,153,471	1,726,734
October	734,748	1,128,183	1,230,860	1,041,966	1,148,089	1,430,238
November	751,443	1,070,204	1,079,037	629,768	1,207,131	1,488,942
December	829,409	943,687	1,039,385	513,187	1,219,174	1,519,050
Total	10,166,234	12,609,949	14,138,740	13,345,230	12,427,463	17,896,526

The total shipments, in cars, for the last eighteen years were as follows:

Total and daily average shipments, in cars, 1888–1905.

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	1905	1,886	688,328

The following table shows the prices prevailing for Connellsville furnace and foundry coke during the years 1901 to 1905. 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, 1901–1905, by months.

Month.	Furnace.						
	1901.	1902.		1903.		1904.	1905.
		Contract price.	For prompt delivery.	Six months' contracts.	Prompt delivery.		
Jan	$1.75	$2.25	$2.50 to $3.50	$3.75 to $4.00	$6.00 to $7.00	$1.60 to $1.65	$2.10 to $3.00
Feb	1.75	2.25	2.50 to 3.00	3.50 to 4.00	4.50 to 5.50	1.50 to 1.65	2.00 to 2.75
Mar	$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	2.25 to 2.50
Apr	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	1.90 to 2.25
May	2.00	2.25 to 2.50	....	3.00 to 3.50	3.50 to 4.00	1.60 to 1.65	1.80 to 2.00
June	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	1.75 to 2.10
July	1.75 to 2.00	2.25	3.00 to 4.00	2.50	2.50	1.40 to 1.50	1.75 to 2.10
Aug	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	1.80 to 2.10
Sept	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	1.90 to 2.50
Oct	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	2.35 to 3.10
Nov	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	2.85 to 3.00
Dec	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	2.75 to 2.90

Month.	Foundry.					
	1901.	1902.*a*	1903.*a*	1903.*b*	1904.	1905.
Jan	$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	$2.25 to $2.75
Feb	2.25	2.75 to 3.00	(*c*)	6.00 to 7.00	2.10 to 2.25	2.50 to 3.00
Mar	2.50	2.75 to 3.00	(*c*)	6.00 to 7.00	2.10 to 2.50	2.75 to 3.25
Apr	2.50	2.75 to 3.00	5.00	5.50 to 6.00	2.15 to 2.50	2.65 to 3.00
May	2.50	2.75 to 3.00	4.00	4.00 to 5.50	2.00 to 2.15	2.50 to 2.75
June	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	2.35 to 2.65
July	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	2.25 to 2.50
Aug	2.25 to 2.50	2.75 to 3.00	3.00	3.00	1.75 to 1.85	2.25 to 2.50
Sept	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	2.40 to 3.00
Oct	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	2.75 to 3.50
Nov	2.25 to 2.50	4.50 to 5.00	....	2.50 to 2.65	2.00 to 2.50	3.50 to 4.00
Dec	2.35 to 2.50	4.50 to 5.00	....	2.15 to 2.50	2.25 to 2.50	3.40 to 4.00

a Contract prices. *b* Prompt delivery. *c* No contract prices quoted.

The prices quoted in the foregoing 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 production of this district, which had shown a steady increase for ten years, fell off about 35 per cent in 1904, but recovered in 1905, the output last year showing an increase of 236,279 tons, or about 75 per cent over 1904, and of nearly 100,000 tons over 1903, when the largest previous production was reported. Four ovens were abandoned in 1905, reducing the number from 1,332 to 1,328. One plant of 10 ovens was idle during the year.

The statistics of production in 1889, when the first ovens were built, in 1890, 1900, and from 1901 to 1905 have been as follows:

Statistics of the manufacture of coke in the Greensburg district, Pennsylvania, 1889–1905.

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
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
1905	7	1,328	100	908,003	551,233	1,155,958	2.096	60.7

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 during all of last year, and the others were operated but a short time during the year. The production, which dropped from 133,290 short tons in 1903 to 8,793 tons in 1904, increased again to 164,601 tons in 1905.

The Irwin district began making coke in 1889. The statistics of production in that year, in 1890, 1900, and from 1901 to 1905 are shown in the following table:

Statistics of the manufacture of coke in the Irwin district, Pennsylvania, 1889–1905.

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
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
1905	5	680	27	258,039	164,601	325,746	1.98	63.8

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 1905 an output nearly double that of the Flat Top district of West Virginia, which until 1902 was the second coke-producing region in the United States. Although 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 record for 1905 shows an increase of nearly 1,000,000 tons over that of 1904, and the increase in the number of establishments and in the number of ovens built and building indicates still greater activity in 1906. The number of establishments increased from 34 in 1904 to 45 in 1905 and the number of ovens from 6,570 to 7,484, while 1,145 new ovens were building at the close of the year. All but 6 of the 45 establishments made coke in 1905, and of the 6 nonproducers 5 were new ones, whose ovens were not completed. The other idle plant consisted of 30 ovens.

The record of the district for the six 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, 1900–1905.

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.*
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
1905	45	7,484	1,145	5,666,812	3,871,310	7,532,382	1.945	68.3

Lebanon Valley and Schuylkill districts.—The Semet-Solvay ovens at Chester were not in operation during 1905, and those at Steelton had not been completed before the close of the year. Both plants at Lebanon, however (90 Semet-Solvay and 232 Otto-Hoffmann ovens), were in operation, the total production from the two plants amounting to 297,716 tons.

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-Hoffmann 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, but increased to 1,463,774 tons in 1905. The number of ovens increased from 2,195 to 2,226, the number of establishments remaining the same. There were 380 ovens in course of construction at the end of the year.

The statistics of production in 1880, 1890, 1900, and from 1901 to 1905 have been as follows:

Statistics of the manufacture of coke in the Pittsburg district, Pennsylvania, 1880–1905.

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	21	534	0	194,393	105,974	$254,500	$2.40	55
1890	14	541	0	149,230	93,984	171,465	1.82	63
1900	8	1,641	0	862,610	570,678	1,418,382	2.48	66.1
1901 [a]	10	1,651	227	1,266,947	813,478	1,690,614	2.078	64.2
1902 [a]	10	1,611	232	1,488,973	953,863	1,924,942	2.018	64.1
1903 [a]	9	1,636	359	1,404,660	877,640	2,632,827	3.00	62.5
1904 [a]	8	2,195	0	1,370,629	841,459	1,795,257	2.13	61.4
1905 [a]	[b] 8	[c] 2,226	380	2,317,159	1,463,774	3,599,436	2.459	63.2

[a] Includes ovens and production in Allegheny Valley district.
[b] Includes 2 establishments in Mercer County and 2 in Allegheny Valley district.
[c] Includes 332 Otto-Hoffmann 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 1905 amounted to 831,904 short tons, compared with 709,502 tons in 1904 and 810,359 tons in 1903. All of the 8 establishments in the district made coke in 1905.

The following are the statistics of the manufacture of coke in the Reynoldsville-Walston district for the years 1880, 1890, 1900, and from 1901 to 1905:

Statistics of the manufacture of coke in the Reynoldsville-Walston district, Pennsylvania, 1880–1905.

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
1890	8	1,737	0	652,966	406,184	771,996	1.90	62
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
1905	8	2,303	200	1,463,680	831,904	1,638,934	1.97	56.8

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 1905 amounted to 755,946 short tons, against 390,540 tons in 1904 and 784,132 tons in 1903.

Statistics of the manufacture of coke in the Upper Connellsville district, Pennsylvania, 1880–1905.

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
1890	14	1,569	28	889,277	577,246	1,008,102	1.75	64.9
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
1905	19	2,434	30	1,159,158	755,946	1,445,568	1.91	65.2

TENNESSEE.

Although the coke product of Tennessee in 1905 was 23.43 per cent larger than it was in 1904, it did not reach the totals made in either 1902 or 1903. The production last year amounted to 468,092 short tons, valued at $1,184,442, against 379,240 short tons, valued at $905,540, in 1904. In 1903 the coke product amounted to 546,875 tons, and in 1902 the highest mark in the history of the State was reached with a production of 560,006 tons.

One establishment was abandoned in 1905, reducing the number from 17 to 16, the same number as was reported in 1903. Of the 16 establishments, 4 with a total of 496 ovens were idle during 1905. One of the idle establishments was the second largest in the State. The number of completed ovens was increased from 2,436 in 1904 to 2,615 in 1905, and 60 new ovens were building at Waldensia at the close of the year.

The statistics of the production of coke in Tennessee for the years 1880, 1890, 1900, and from 1901 to 1905 have been as follows:

Statistics of the manufacture of coke in Tennessee, 1880–1905.

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	656	68	217,656	130,609	$316,607	$2.42	60
1890	11	1,664	292	600,387	348,728	684,116	1.96	58
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
1905	16	2,615	60	862,320	468,092	1,184,442	2.53	54.3

The character of the coal used in the manufacture of coke in Tennessee is nearly equally divided between run of mine and slack, most of which is washed before coking. Nearly 80 per cent of the coal used in 1905 was washed, as shown in the following table:

Character of coal used in the manufacture of coke in Tennessee, 1890–1905.

[Short tons.]

Year.	Run of mine.		Slack.		Total.
	Unwashed.	Washed.	Unwashed.	Washed.	
1890	255,359	0	273,028	72,000	600,387
1895	96,744	59,284	285,906	242,721	684,655
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
1905	134,432	244,302	46,073	437,513	862,320

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 has during the last ten years been exceptionally rapid and the State now ranks fourth among the coke producers. Since 1893 there has been only one year in which there was a decreased output and this was in 1904, when production fell off generally throughout the United States, and the loss shown by Virginia in that year was so small as to be practically negligible. The production in 1905 amounted to 1,499,481 short tons, against 1,101,716 tons in 1904 and 1,176,439 in 1903, the record year prior to 1905. The increase over 1904 was 397,765, or 36.1 per cent, and over 1903 the increase was 323,042 tons, or 27.5 per cent. The value increased from $1,772,717 in 1904 to $2,869,452 in 1905, a gain of $1,096,735, or 62 per cent. The number of establishments has been the same, 16, during the last three years, but the number of ovens has increased from 4,251 in 1903 to 4,345 in 1904 and to 4,549 in 1905. Of the 16 establishments, 2, with a total of 107 ovens, were idle in 1905. One of these was the plant of 56 Newton-Chambers ovens at Pocahontas, which have not been operated for several years.

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 for the year 1883, when the industry was first established, in 1890, 1900, and from 1901 to 1905:

Statistics of the manufacture of coke in Virginia, 1883–1905.

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
1890	2	550	250	251,683	165,847	278,724	1.68	66
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
1905	16	*a*4,549	0	2,184,369	1,499,481	2,869,452	1.913	68.6

a Includes 56 Newton-Chambers by-product ovens.

The character of the coal used in the manufacture of coke in Virginia in 1905 was nearly equally divided between run of mine and slack, all of which was used raw or unwashed. Some washing of the coal was attempted a few years ago, and a small amount was washed in 1904, but these trials have done little more than demonstrate that the coal does not need washing in order to make a good coke.

Character of coal used in the manufacture of coke in Virginia, 1890–1905.

[Short tons.]

Year.	Run of mine.		Slack.		Total.
	Unwashed.	Washed.	Unwashed.	Washed.	
1890	98,215	0	153,468	0	251,683
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
1905	1,096,656	0	1,087,713	0	2,184,369

WASHINGTON.

Washington is the only one of the Pacific coast States producing coal of a quality suitable for the manufacture of coke. The operations are not of special importance, particularly when they are compared with the output of other coke-producing States, but they are of interest as establishing the fact that it is possible to produce a metallurgical coke from the Washington coals. There were 5 establishments in the State at the close of 1905, a decrease of 1 from 1904, 1 establishment of 40 ovens having been abandoned. Of the other 5 establishments, 2 with a total of 31 ovens were idle, both in 1904 and 1905. The 3 establishments which have made coke in the last three years include 185 ovens. The amount of production of the State has not varied much in the last five years, although the percentage of increase in 1905 over 1904 was 17.

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, 1884–1905.

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
1890	2	30	80	9,120	5,837	46,696	8.00	64
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
1905	5	216	0	85,715	53,137	251,717	4.74	62

WEST VIRGINIA.

With an increase in coke production of over a million tons in 1905, West Virginia, for the third time in the last five years and for the eleventh time in twenty-one years, occupies second place in the rank of coke-producing States, a position which this State and Alabama have taken almost alternately for more than a decade. The exceptionally large production of West Virginia in 1905 (exceeding that of Alabama by over 800,000 tons, or more than 30 per cent), coupled with the greater activity in construction of new ovens, indicates that the State will now continue to rank next to Pennsylvania as a producer of coke. During the last two or three years there has been a rapid extension of railroad lines in West Virginia, the older transportation companies building branch "feeders" into new coal fields, while several new roads are rapidly pushing construction. Probably the most important of these new lines is the Deepwater-Tidewater Railroad, building from Norfolk, or Sewells Point, Va., to the coal fields in the southern portion of the State. This road will penetrate the fields of the Pocahontas, the New River, and the Kanawha series. The present western terminus is at Deepwater on the Kanawha River, a short distance below Kanawha Falls, and shipments of coal from this portion of the road (about 50 miles of which were completed before the close of 1905), by connection with the Chesapeake and Ohio Railroad at Deepwater, were begun in the summer of 1905. Simultaneously with the beginning of the railroad building, coke-oven construction was begun, and, by the close of 1905, 505 ovens were completed at Page on Lower Loup Creek, and a few thousand tons of coke shipped from there were included in the production of the Kanawha district, to which series the coals at this point belong.

Important coal fields in the central part of the State are also being opened up by the building of the Coal and Coke Railway from Charleston to Elkins, this road almost crossing the State in a northeast-southwest direction, while the eastern connections of the Wabash Railroad interests now building to tide water will give an additional outlet for the coals and cokes of the northern part of the State. Important developments have also been made on the line of the Morgantown and Kingwood Railroad in the northern part of the State, where the Freeport coal of Pennsylvania is well developed and which here possesses excellent coking qualities. The rapid progress made in the Tug River district, lying west of and contiguous to the Flat Top district on the Norfolk and Western Railroad, is also of prime importance to the coking industry of the State. The Tug River production was largely responsible for the increased output of the State in 1905.

The coke production of West Virginia in 1905 amounted to 3,400,593 short tons, valued at $6,548,205, against 2,283,086 tons, worth $3,757,850, in 1904, an increase of 1,117,507 tons, or 49 per cent in quantity, and of $2,790,355, or 74.5 per cent in value.

The number of establishments increased from 137 in 1904 to 143 in 1905, a gain of 6. The number of completed ovens increased from 16,929 to 19,189, a gain of 2,260, and there were 1,214 ovens building at the close of 1905, compared with 1,319 in 1904. Of the 143 establishments in 1905, 33 were idle, but 4 of these were new, the ovens not having been completed before the close of 1905. Nineteen of the idle establishments were in the Upper Monongahela district. The total number of idle ovens, exclusive of those not completed, was 2,083.

The following table exhibits the statistics of coke production in West Virginia in 1880, 1890, 1900, and from 1901 to 1905:

Statistics of the manufacture of coke in West Virginia, 1880–1905.

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
1890	55	4,060	334	1,395,266	833,377	1,524,746	1.83	60
1900	106	a10,249	1,306	3,868,840	2,358,499	4,746,633	2.01	60.9
1901	112	a11,544	1,254	3,734,076	2,283,700	4,110,011	1.80	61.1
1902	120	a12,656	2,341	4,078,579	2,516,505	5,833,226	2.318	61.7
1903	136	a15,613	2,687	4,347,160	2,707,818	7,115,842	2.628	62.3
1904	137	a16,929	1,319	3,543,338	2,283,086	3,757,850	1.646	64.4
1905	143	a19,189	1,214	5,329,695	3,400,593	6,548,205	1.92	63.8

a 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
1895	405,725	24,054	1,476,003	182,034	2,087,816
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
1905	1,445,099	1,950	3,577,793	304,853	5,329,695

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 1905 the production of each district was increased, that of the Flat Top-Tug River district showing the largest increase in point of tonnage and the Kanawha district showing the largest percentage.

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 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	14	1,112	600	152,517	92,014	142,858	1.55	60.3
New River	26	2,156	18	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.

Production of coke in West Virginia in 1905, 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]	56	11,287	1,074	3,162,820	2,042,123	$3,604,923	$1.765	64.6
Kanawha	14	1,617	0	415,808	249,251	504,734	2.025	60
New River	25	2,129	0	514,850	301,626	622,815	2.06	58.6
Upper Monongahela	39	[b]2,861	90	576,201	389,213	965,402	2.48	67.5
Upper Potomac and Tygarts Valley	9	1,295	50	660,016	418,380	850,331	2.03	63.4
Total	143	19,189	1,214	5,329,695	3,400,593	6,548,205	1.92	63.8

[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 2,022 ovens up to the close of 1905 and had 129 ovens building December 31. The production of the Flat Top district (including Tug River) amounted in 1905 to 2,042,123 short tons, against 1,320,314 tons in 1904, an increase of 721,809 tons, or nearly 55 per cent. There was an increase of 3—from 53 to 56—in the number of establishments, but two of the new plants were not completed, and of the third, only a few of the 818 ovens begun in 1905 were put in blast before the close of the year. The Flat Top district began producing coke in 1886. The output for that year and for 1890, and that of the Flat Top-Tug River district since 1900, has been as follows:

Statistics of the manufacture of coke in the Flat Top district of West Virginia, 1886–1905.

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
1890	17	1,584	252	566,118	325,576	571,239	1.75	57.5
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
1905	56	11,287	1,074	3,162,820	2,042,123	3,604,923	1.765	64.6

[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, and while the record for 1905 shows an increase over 1904, the production last year was less than in any year from 1900 to 1903, inclusive.

The statistics of the manufacture of coke in the New River district in 1880, 1890, 1900, and from 1901 to 1905, have been as follows:

Statistics of the manufacture of coke in the New River district, West Virginia, 1880–1905.

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	468	40	159,032	98,427	$239,977	$2.14	62
1890	12	773	4	275,458	174,295	377,847	2.17	63
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	26	2,156	18	387,265	233,014	439,521	1.89	60.2
1905	25	2,129	0	514,850	301,626	622,815	2.06	58.6

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. It also includes the new developments on Lower Loup Creek, reference to which was made on a preceding page and which added over 500 ovens to the producing capacity of this district in 1905. The production of the district, which had shown a declining tendency since 1899 (except in 1903), took a decided jump in 1905 and made the record output of 249,251 tons in 1905, and the probabilities are that this will be considerably increased in 1906.

The statistics of the manufacture of coke in the Kanawha district in 1880, 1890, 1900, and from 1901 to 1905, have been as follows:

Statistics of the manufacture of coke in the Kanawha district, West Virginia, 1880–1905.

Year.	Establishments.	Ovens. Built.	Ovens. Building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	4	18	0	6,789	4,300	$9,890	$2.30	63.3
1890	6	474	0	182,340	104,076	196,583	1.89	57
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	14	1,112	600	152,517	92,014	142,858	1.55	60.3
1905	14	1,617	0	415,808	249,251	504,734	2.025	60

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 1905 was 389,213 short tons against 328,820 tons in 1904. Of the 39 establishments and 2,861 ovens in the district, 19 establishments, having a total of 1,048 ovens, were idle last year.

The statistics of coke production in the Upper Monongahela district in 1880, 1890, 1900, and from 1901 to 1905, are shown in the following table:

Statistics of the manufacture of coke in the Upper Monongahela district, West Virginia, 1880–1905.

Year.	Establishments.	Ovens.		Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
		Built.	Building.					
				Short tons.	*Short tons.*			*Per cent.*
1880	8	145	0	64,937	36,028	$68,930	$1.91	55
1890	18	1,051	50	276,367	167,459	260,574	1.56	60
1900	24	[a]1,563	0	584,265	355,861	817,340	2.297	60.9
1901	25	[a]1,685	0	497,215	317,470	657,232	2.07	63.8
1902	31	[a]1,698	75	916,322	547,497	1,617,389	2.95	59.7
1903	37	[a]2,319	337	724,915	437,522	1,315,336	3.01	60.3
1904	37	[a]2,348	17	478,513	328,820	749,305	2.28	68.7
1905	39	[a]2,861	90	576,201	389,213	965,402	2.48	67.5

[a] 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 since 1902 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 1905 amounted to 418,380 short tons, against 308,924 tons in 1904. One establishment of 17 ovens was idle in 1905, and one other of 50 ovens was not completed before the end of the year.

The statistics of the manufacture of coke in the Upper Potomac and Tygarts Valley district in 1887, 1890, 1900, and from 1901 to 1905, are shown in the following table:

Statistics of the manufacture of coke in the Upper Potomac and Tygarts Valley district, West Virginia, 1887–1905.

Year.	Establishments.	Ovens.		Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
		Built.	Building.					
				Short tons.	*Short tons.*			*Per cent.*
1887	1	20	50	3,565	2,211	$4,422	$2.00	62
1890	2	178	28	94,983	61,971	118,503	1.91	65
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
1905	9	1,295	50	660,016	418,380	850,331	2.03	63.4

OTHER STATES.

In the following table are presented the statistics of production in the years 1900 to 1905 of those States in which there are but one or two establishments. These States are Indiana, Maryland, Massachusetts, Michigan, Minnesota, New Jersey, 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.

The statistics of production for 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 1905 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	832	594	708,295	506,730	$1,454,029	$2.87	71.5
1901	11	862	609	793,187	564,191	1,607,476	2.849	71
1902	11	898	742	852,977	598,869	2,063,894	3.446	70.2
1903	17	1,308	760	1,306,707	932,428	3,228,064	3.46	71.3
1904	14	1,753	658	2,046,340	1,469,845	4,830,621	3.286	71 8
1905	12	[a] 1,666	[b] 145	2,222,723	1,660,857	5,500,337	3.31	74.7

[a] Includes 270 Semet-Solvay, 953 Otto-Hoffmann, and 141 Rothberg ovens.
[b] Includes 80 Semet-Solvay and 65 Otto-Hoffmann ovens.

Of the total production of 1,660,857 short tons in 1905, shown in the preceding table, 1,617,355 short tons, or 97 per cent, were made in by-product retort ovens. This is a little less than half of the total production of by-product coke in 1905.

GAS, COKE, TAR, AND AMMONIA.

By Edward W. Parker.

INTRODUCTION.

Since 1902 a chapter devoted to the production of gas, coke, tar, and ammonia has been incorporated in the annual volume, Mineral Resources of the United States. This has been somewhat as a supplement to the reports on the production of coal and the manufacture of coke and in response to a demand from producers of gas and coke and of the by-products of tar and ammonia for statistical information on these subjects. Previous to 1902 (in 1898) a special chapter on these subjects was prepared for this report, and the annual reviews since 1902 have followed in a general way the same lines as the 1898 report. The present report includes, in addition to the statistics of the production of gas, coke, tar, and ammonia at gas works and in by-product coke ovens, a statement of the production in 1905 of the quantity of gas and tar produced at water-gas works using crude oil for enriching purposes. These statistics have not been considered in any of the preceding reports. At some of the gas houses oil is used with the coal in the production of gas, but the entire production is included in the statistics of coal gas.

The report for 1898 was compiled from returns received from 433 companies manufacturing gas from coal. It did not, however, include the output of gas, tar, and ammonia produced at the 520 by-product coke ovens in operation that year. The statistics for 1902 and succeeding years have included the production from both gas works and by-product coke plants, and, as previously stated, the present chapter contains in addition a statement of the production of gas and tar from water-gas works.

In 1902 there were 533 companies reporting, an increase of 100 from 1898. The reports included the returns from 1,663 by-product coke ovens. In 1903, 528 coal-gas companies reported, the production including the output of 1,956 by-product ovens. In 1904 reports were received from 534 companies and included the production from 2,910 by-product ovens. The current chapter is made up from reports received from 529 companies and includes the output of 2,998 by-product ovens. The comparatively stationary condition of the statistics, so far as the number of companies reporting during the last four years is concerned, is probably due to the fact that most of the development in gas making in late years (outside of the by-product coke oven construction) has been in the manufacture of water gas. There were in operation in the United States in 1905 477 water-gas companies which reported their production to the United States Geological Survey. These companies produced a total of 82,959,000,000 cubic feet of gas, while the total production from coal-gas works and by-product ovens was 43,655,000,000 cubic feet, which shows that nearly two-thirds of the total quantity of gas produced was water gas. About 8 per cent of the coal gas and nearly 7 per cent of the water gas made was lost by leakage, fire, or otherwise, the total quantity of coal gas saved and sold being 40,454,000,000 cubic feet and of water gas 77,412,000,000 cubic feet. Of the coal gas sold 26,818,000,000 cubic feet were for illuminating and 13,636,000,000 cubic feet for fuel purposes. Of the water gas 59,532,000,000 cubic feet were sold for illuminating and 17,880,000,000 cubic feet for fuel. The total gas sold for illuminating purposes was, therefore, 86,350,000,000 cubic feet and for fuel 31,516,000,000 cubic feet, indicating that 73 per cent, or nearly three-fourths of the total consumption, was for light and 27 per cent for heat.

PRODUCTION.

Excluding the operations of oil and water gas works, whose production has not been considered in the preceding reports of this series but which are considered at the close of this chapter, the following statistics are presented:

The total quantity of coal carbonized at coal-gas works and in by-product coke ovens in 1905 was 8,187,812 short tons, of which 4,628,981 short tons, or over 55 per cent, were consumed at by-product oven plants and 3,558,831 short tons, or something less than 45 per cent, were used at gas works. In 1904, when the total quantity of coal used was 7,058,157 short tons, the consumption was nearly equally divided between the gas houses and the oven plants; and in 1903, when the total quantity of coal carbonized was 5,843,538 short tons, the gas houses used 3,238,085 short tons and the oven plants 2,605,453 short tons. From this it will be seen that while in two years the consumption of coal in gas houses has increased only about 10 per cent, that used in by-product ovens has increased over 2,000,000 tons, or nearly 80 per cent. Eighty per cent of the increased consumption in 1904 over 1903 and practically all of the increase in 1905 over 1904 was in by-product ovens.

The total production in 1905 was 40,454,215,132 cubic feet of gas (not including that lost or wasted), 5,751,378 short tons of coke, 80,022,043 gallons of tar, 46,986,268 gallons of ammonia liquor (equivalent to 22,455,857 pounds of anhydrous ammonia), and 38,663,682 pounds of ammonia sulphate, against 34,814,991,273 cubic feet of gas, 4,716,049 short tons of coke, 69,498,085 gallons of tar, 52,220,484 gallons of ammonia liquor (equivalent to 19,750,032 pounds of anhydrous ammonia), and 28,225,210 pounds of ammonia sulphate in 1904. The total value of all these products in 1905 was $56,684,972, against $51,157,736 in 1904.

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 and 1905. 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 quantity 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 quantity of gas sold at gas works per ton of coal coked was 8,633 cubic feet in 1905, as compared with 2,102 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 1905 would have been 46,289,810,000 cubic feet.

Coal consumed and gas, coke, and tar produced at coal-gas works and in by-product coke ovens in the United States in 1904 and 1905.

Kind of product.	Gas works.	By-product coke plants.	Total.
1904.			
Coal coked......short tons..	3,485,208	3,572,949	7,058,157
Coal 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
1905.			
Coal coked......short tons..	3,558,831	4,628,981	8,187,812
Coal gas produced and sold......cubic feet..	30,722,278,832	9,731,936,300	40,454,215,132
Coke produced......short tons..	2,289,030	3,462,348	5,751,378
Tar produced......gallons..	43,642,189	36,379,854	80,022,043

Since 1902 the total quantity and value of these products and of ammonia liquor and sulphate have been as follows:

Production of gas, coke, tar, and ammonia, and value thereof, at gas works and by-product coke ovens in the United States, 1902–1905.

	1902.		1903.	
	Quantity.	Value.	Quantity.	Value.
Gas sold.....cubic feet..	29,079,073,555	$29,342,881	31,049,461,511	$30,315,776
Coke.....short tons..	3,373,294	11,251,164	3,941,282	13,634,095
Tar.....gallons..	53,099,508	1,871,243	62,964,393	2,199,969
Ammonia (reduced to NH_3).....pounds..	14,906,813	1,057,922	17,643,507	1,291,732
Ammonia sulphate.....do....	11,276,502	319,685	12,400,032	389,028

	1904.		1905.	
	Quantity.	Value.	Quantity.	Value.
Gas sold.....cubic feet..	34,814,991,273	$32,090,998	40,454,215,132	$32,937,456
Coke.....short tons..	4,716,049	14,693,126	5,751,378	18,844,866
Tar.....gallons..	69,498,085	2,114,421	80,022,043	2,176,944
Ammonia (reduced to NH_3).....pounds..	19,750,032	1,487,196	22,455,857	1,728,254
Ammonia sulphate.....do....	28,225,210	771,995	38,663,682	997,452

PRODUCTION OF GAS.

The quantity of gas produced at gas works and by-product coke works in 1905, as reported by the 529 companies who made returns to the Geological Survey, amounted to 43,654,807,037 cubic feet. Of this amount 3,200,591,905 cubic feet were lost through leakage, fire, or otherwise and reported as "unaccounted for." The net product sold, therefore, amounted to 40,454,215,132 cubic feet, which was valued at $32,937,456, or an average of 81.4 cents per thousand cubic feet. In 1904 the total quantity of gas sold was 34,814,991,273 cubic feet, valued at $32,090,998, an average of 92 cents per thousand cubic feet, and in 1903 the quantity sold was 31,049,461,511 cubic feet, valued at $30,315,776, or an average of 97 cents per thousand cubic feet. These figures indicate quite a decided decline in the selling price of gas, and it is interesting to note that the average price of bituminous coal at the mines during the same period has declined from $1.24 per short ton, in 1903, to $1.10, in 1904, and to $1.06, in 1905. The decline in gas values may, however, be attributed largely to the increased use of fuel gas, which is particularly noticeable in the statistics for 1905. In 1903 the amount of gas sold for fuel purposes was about 8,100,000,000 cubic feet, at an average price of 98 cents per thousand; in 1904 the sales of fuel gas were a little less than 9,000,000,000 cubic feet, at an average price of 96 cents, while in 1905 the consumption amounted to over 13,600,000,000 cubic feet, with an average value of 72 cents per thousand. At the same time there has been a decline in the average price of illuminating gas from 97 cents in 1903 to 91 cents in 1904 and to 86 cents in 1905.

Compared with 1904 the total production of gas in 1905 (excluding gas lost or unaccounted for) shows an increase of 5,639,223,859 cubic feet, or 16 per cent. The total value increased $846,458, or 2.6 per cent. Of the total increase in production, 4,685,485,021 cubic feet, or more than 83 per cent, was in the quantity of gas sold for fuel purposes. In 1905 the quantity of gas sold for illuminating purposes was 26,817,836,022 cubic feet, against 25,864,097,184 cubic feet in 1904. The fuel-gas sales were 13,636,379,110 cubic feet in 1905, against 8,950,894,089 cubic feet in 1904.[a]

New York remains in first place as a producer and consumer of gas, the quantity of coal gas made and sold in that State in 1905 amounting to a little over 5,000,000,000 cubic feet, a decrease of 260,000,000 cubic feet from 1904. In the production of water gas New York far outranks all other States, with more than one-third of the total. Massachusetts supplanted Ohio in 1905 in the total quantity of gas consumed, though the latter State exceeded the former in gross production. The quantity of gas unaccounted for in Ohio, however, was more than double that in Massachusetts, which gave the latter State a slight advantage, with a total net production of 4,975,000,000 cubic feet, as compared with 4,729,000,000 cubic feet for Ohio. Massachusetts is also an important producer of water gas, while Ohio's production is comparatively insignificant. Pennsylvania is fourth in the manufacture of coal gas, with a net production in 1905 amounting to 3,911,000,000 cubic feet. This State is also an important producer of water gas, being third in rank (Illinois standing second), with a net production in 1905 of 8,500,000,000 cubic feet. Michigan ranks fifth in the production of coal gas, with sales amounting to 3,264,000,000 cubic feet in 1905. Alabama, by reason of the development of by-product coke making in the State, shows a remarkable increase in the quantity of gas sold for fuel purposes and leads all the other States in this regard, with Pennsylvania second, Ohio third, and Michigan fourth.

In the quantity of coal carbonized Pennsylvania stands first, Massachusetts second, Ohio third, New York fourth, and Michigan fifth, the first two leading in this respect because of the large quantity of coal used in by-product coke ovens, the greater part of the gas produced therein being consumed in the process of coking.

In the following table is shown a statement of the production of gas in 1904 and 1905, 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.

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[a] In addition to the gas produced at coal gas and by-product oven works in 1905, there entered into consumption 77,412,024,591 cubic feet of "water" gas, of which approximately 59,530,000,000 cubic feet were sold for illuminating purposes and 17,880,000,000 cubic feet for fuel purpose. From this it appears that more than twice as much water gas as coal gas is used for light and that nearly two-thirds of all the gas consumed is "water" gas. The details of water-gas production in 1905 are given in a subsequent table. Prior to 1905 these statistics were not compiled by the Geological Survey.

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	68,438,633	30,831,078	71,330	2.31	28,142,555	54.789	1.95	58,973,633	126,119	2.14	9,464,700

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—Continued.

State.	Number of establishments.	Quantity of coal carbonized.	Total quantity gas produced.	Gas sold for illuminating purposes.			Gas sold for fuel purposes.			Total gas sold.			Quantity of gas unaccounted for.
				Quantity.	Value.	Price per 1,000 cubic feet.	Quantity.	Value.	Price per 1,000 cubic feet.	Quantity.	Value.	Average price per 1,000 cubic feet.	
		Short tons.	*Cubic feet.*	*Cubic feet.*			*Cubic feet.*			*Cubic feet.*			*Cubic feet.*
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	a7,058,157	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	2,856,848,400

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 1905, 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.	Price per 1,000 cubic feet.	
		Short tons.	*Cubic feet.*	*Cubic feet.*			*Cubic feet.*			*Cubic feet.*			*Cubic feet.*
Alabama	11	543,404	1,958,779,780	88,178,060	$112,931	$1.28	1,817,320,120	$316,886	$0.17	1,905,498,180	$429,817	$0.22	53,281,600
Arkansas	4	6,228	53,414,400	32,893,940	47,006	1.43	19,020,460	25,020	1.31	51,914,400	72,026	1.39	1,500,000
California	3	3,192	30,634,128	11,463,121	24,016	2.09	19,010,912	23,777	1.25	30,474,033	47,793	1.56	160,095
Colorado	5	53,111	534,602,500	186,837,850	246,399	1.32	309,857,229	310,518	1.00	496,695,079	556,917	1.12	37,907,421
Connecticut	7	61,176	569,782,880	333,878,920	368,600	1.10	193,224,660	210,953	1.09	527,103,580	579,553	1.09	42,679,300
Delaware	3	7,790	69,557,200	38,280,500	38,504	1.00	22,409,500	22,722	1.00	60,690,000	61,226	1.00	8,867,200
Florida, Louisiana, and Mississippi	7	10,152	82,705,000	29,387,000	45,188	1.54	38,316,000	45,801	1.19	67,703,000	90,989	1.34	15,002,000
Georgia	9	54,209	480,648,600	243,059,500	266,673	1.09	225,513,350	224,465	.99	468,572,850	491,138	1.04	12,075,750
Idaho, North and South Dakota, Utah, and Wyoming	8	15,403	135,539,636	40,528,052	70,648	1.74	67,676,760	96,057	1.42	108,204,812	166,705	1.54	27,334,824
Illinois	41	217,723	1,970,609,660	850,373,945	945,351	1.11	917,812,387	967,517	1.05	1,768,186,332	1,912,868	1.08	202,423,328
Indiana	33	149,521	1,333,705,443	704,757,008	680,893	.96	511,415,966	489,054	.95	1,216,172,974	1,169,947	.96	117,532,469
Indian Territory and Oklahoma	5	6,610	52,194,000	13,834,000	16,163	1.16	38,360,000	39,629	1.03	52,194,000	55,792	1.07	....
Iowa	16	61,875	578,175,500	288,383,885	350,780	1.21	246,363,765	282,777	1.14	534,747,650	633,557	1.19	43,427,850
Kansas	7	19,150	172,128,000	46,598,400	73,582	1.58	105,249,000	120,728	1.14	151,847,400	194,510	1.28	20,280,600
Kentucky	12	81,285	690,614,347	335,862,264	364,032	1.08	260,466,256	175,692	.67	596,328,520	539,724	.90	94,285,827
Maine	7	17,128	176,418,780	106,969,415	151,363	1.41	47,099,060	60,894	1.29	154,068,475	212,257	1.37	22,350,305
Maryland and District of Columbia	8	540,647	1,798,698,675	1,713,957,825	551,735	.32	39,812,184	44,623	1.12	1,753,770,009	596,358	.34	44,928,666
Massachusetts	44	940,737	5,197,704,036	4,489,764,701	3,050,561	.68	485,697,024	523,555	1.07	4,975,461,725	3,574,116	.71	222,242,311
Michigan	42	626,166	3,440,593,395	2,153,938,046	1,373,993	.63	1,109,665,013	951,384	.85	3,263,603,059	2,325,377	.71	176,990,336
Minnesota	8	190,729	882,820,400	567,219,410	542,951	.96	267,471,800	299,648	1.12	834,691,210	842,599	1.01	48,129,190
Missouri	19	194,690	1,842,195,200	872,796,283	897,148	1.02	800,159,418	658,969	.82	1,672,955,701	1,556,117	.93	169,239,499
Montana, Nevada, and New Mexico	4	8,193	70,343,350	18,992,720	42,869	2.25	43,529,980	72,084	1.65	62,522,700	114,953	1.84	7,820,650

Quantity and value of gas produced and sold at by-product coke plants and coal-gas works of the United States in 1905, by States—Continued.

State.	Number of establishments.	Quantity of coal carbonized.	Total quantity gas produced.	Gas sold for illuminating purposes.			Gas sold for fuel purposes.			Total gas sold.			Quantity of gas unaccounted for.
				Quantity.	Value.	Price per 1,000 cubic feet.	Quantity.	Value.	Price per 1,000 cubic feet.	Quantity.	Value.	Price per 1,000 cubic feet.	
		Short tons.	*Cubic feet.*	*Cubic feet.*			*Cubic feet.*			*Cubic feet.*			*Cubic feet.*
Nebraska	3	7,743	74,971,100	31,909,000	$40,632	$1.27	33,644,100	$42,931	$1.27	65,553,100	$83,563	$1.27	9,418,000
New Hampshire and Vermont	7	21,996	212,837,100	143,596,884	191,915	1.33	47,168,630	63,625	1.34	190,765,514	255,540	1.34	22,071,586
New Jersey	16	259,492	1,571,352,900	1,144,064,312	1,217,897	1.06	338,967,700	367,786	1.08	1,483,032,012	1,585,683	1.07	88,320,888
New York	51	689,726	5,481,602,963	4,417,698,676	4,442,425	1.00	586,968,718	647,632	1.10	5,004,667,394	5,090,057	1.01	476,935,569
North Carolina	6	10,198	73,758,900	35,969,300	58,374	1.62	22,878,930	27,637	1.20	58,848,230	86,011	1.46	14,910,670
Ohio	40	694,735	5,303,924,990	3,031,002,133	2,354,462	77	1,697,775,622	926,210	.54	4,728,777,755	3,280,672	.69	575,147,235
Oregon	3	2,268	18,716,200	10,580,300	25,025	2.36	7,550,900	14,650	1.94	18,131,200	39,675	2.18	585,000
Pennsylvania	30	1,883,037	4,054,510,624	2,190,416,022	2,094,618	.96	1,720,253,283	173,887	.10	3,910,669,305	2,268,505	.58	143,841,319
Rhode Island	3	53,753	536,291,500	318,018,020	375,203	1.18	172,448,380	173,430	1.00	490,466,400	548,633	1.12	45,825,100
South Carolina	3	14,634	133,167,670	74,120,820	107,627	1.45	42,810,350	52,082	1.21	116,931,170	159,709	1.36	16,236,500
Tennessee	8	63,945	523,716,100	272,772,407	289,718	1.06	156,402,793	145,000	.92	430,175,200	434,718	1.01	93,540,900
Texas	10	19,188	177,287,790	60,402,007	105,997	1.75	106,515,665	147,569	1.38	166,917,672	253,566	1.52	10,370,118
Virginia	13	55,657	513,801,470	322,709,181	376,645	1.16	97,711,297	108,723	1.11	420,420,478	485,368	1.15	93,380,992
Washington	7	40,655	395,641,060	204,039,265	256,381	1.25	155,141,011	202,722	1.30	359,180,276	459,103	1.27	36,460,784
West Virginia	6	169,476	163,045,260	126,022,460	96,986	.76	3,912,800	5,869	1.50	129,935,260	102,855	.79	33,110,000
Wisconsin	20	392,190	2,298,316,500	1,265,560,390	843,070	.66	860,778,087	736,589	.85	2,126,338,477	1,579,659	.74	171,978,023
Total	529	*a*8,187,812	43,654,807,037	26,817,836,022	23,138,361	.863	13,636,379,110	9,799,095	.719	40,454,215,132	32,937,456	.814	3,200,591,905

a Includes 745,342 tons of coal carbonized in by-product coke ovens, none of the gas produced from it being sold.

Of the total production of 43,654,807,037 cubic feet of coal gas made in 1905, 3,200,-591,905 cubic feet, or 7.3 per cent, were lost by leakage, fire, or otherwise, as compared with a loss of 2,856,848,400 cubic feet, or 7.6 per cent, out of a total production of 37,671,839,673 cubic feet in 1904. The largest relative losses in 1905 were shown in the production of West Virginia, in the combined production of Idaho, North and South Dakota, Utah, and Wyoming, and in North Carolina. The smallest losses were made in California, Georgia, Maryland, the District of Columbia, Alabama, and Arkansas. No loss was reported in Indian Territory and Oklahoma. There were 11 States and Territories that reported losses of less than 5 per cent, and 25 in which the losses exceeded 10 per cent.

In the following table is shown the total quantity of gas produced in each State, ranged according to rank, in 1904 and 1905, 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 coal-gas production and the quantity sold and unaccounted for in 1904 and 1905, by States.

1904.

Rank.	State.	Total production.	Gas sold.		Gas unaccounted for.	
			Quantity.	Per cent.	Quantity.	Per cent.
		Cubic feet.	*Cubic feet.*		*Cubic feet.*	
1	New York	5,682,106,080	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

Rank of States in coal-gas production and the quantity sold and unaccounted for in 1904 and 1905, by States—Continued.

1904.

Rank.	State.	Total production.	Gas sold.		Gas unaccounted for.	
			Quantity.	Per cent.	Quantity.	Per cent.
		Cubic feet.	*Cubic feet.*		*Cubic feet.*	
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

1905.

Rank.	State.	Total production.	Gas sold: Quantity.	Gas sold: Per cent.	Gas unaccounted for: Quantity.	Gas unaccounted for: Per cent.
1	New York	5,481,602,963	5,004,667,394	91.3	476,935,569	8.7
2	Ohio	5,303,924,990	4,728,777,755	89.2	575,147,235	10.8
3	Massachusetts	5,197,704,036	4,975,461,725	95.7	222,242,311	4.3
4	Pennsylvania	4,054,510,624	3,910,669,305	96.5	143,841,319	3.5
5	Michigan	3,440,593,395	3,263,603,059	94.9	176,990,336	5.1
6	Wisconsin	2,298,316,500	2,126,338,477	92.5	171,978,023	7.5
7	Illinois	1,970,609,660	1,768,186,332	89.7	202,423,328	10.3
8	Alabama	1,958,779,780	1,905,498,180	97.3	53,281,600	2.7
9	Missouri	1,842,195,200	1,672,955,701	90.8	169,239,499	9.2
10	District of Columbia and Maryland	1,798,698,675	1,753,770,009	97.5	44,928,666	2.5
11	New Jersey	1,571,352,900	1,483,032,012	94.4	88,320,888	5.6
12	Indiana	1,333,705,443	1,216,172,974	91.2	117,532,469	8.8
13	Minnesota	882,820,400	834,691,210	94.5	48,129,190	5.5
14	Kentucky	690,614,347	596,328,520	86.4	94,285,827	13.6
15	Iowa	578,175,500	534,747,650	92.5	43,427,850	7.5
16	Connecticut	569,782,880	527,103,580	92.5	42,679,300	7.5
17	Rhode Island	536,291,500	490,466,400	91.5	45,825,100	8.5
18	Colorado	534,602,500	496,695,079	92.9	37,907,421	7.1
19	Tennessee	523,716,100	430,175,200	82.1	93,540,900	17.9
20	Virginia	513,801,470	420,420,478	81.8	93,380,992	18.2
21	Georgia	480,648,600	468,572,850	97.5	12,075,750	2.5
22	Washington	395,641,060	359,180,276	90.8	36,460,784	9.2
23	New Hampshire and Vermont	212,837,100	190,765,514	89.6	22,071,586	10.4
24	Texas	177,287,790	166,917,672	94.2	10,370,118	5.8
25	Maine	176,418,780	154,068,475	87.4	22,350,305	12.6
26	Kansas	172,128,000	151,847,400	88.2	20,280,600	11.8
27	West Virginia	163,045,260	129,935,260	79.7	33,110,000	20.3
28	Idaho, North and South Dakota, Utah, and Wyoming	135,539,636	108,204,812	79.8	27,334,824	20.2
29	South Carolina	133,167,670	116,931,170	87.8	16,236,500	12.2
30	Florida, Louisiana, and Mississippi	82,705,000	67,703,000	81.9	15,002,000	18.1
31	Nebraska	74,971,100	65,553,100	87.4	9,418,000	12.6
32	North Carolina	73,758,900	58,848,230	79.8	14,910,670	20.2
33	Montana, Nevada, and New Mexico	70,343,350	62,522,700	88.9	7,820,650	11.1
34	Delaware	69,557,200	60,690,000	87.3	8,867,200	12.7
35	Arkansas	53,414,400	51,914,400	97.2	1,500,000	2.8
36	Indian Territory and Oklahoma	52,194,000	52,194,000	100		
37	California	30,634,128	30,474,033	99.5	160,095	.5
38	Oregon	18,716,200	18,131,200	96.9	585,000	3.1
	Total	43,654,807,037	40,454,215,132	92.7	3,200,591,905	7.3

In the three years preceding 1905, during which these statistics have been compiled by the Geological Survey, about three-fourths of all the coal gas produced and sold was used for illuminating purposes, 74 per cent being so consumed in 1904, 75 per cent in 1903, and 80.45 per cent in 1902. The returns for 1905, however, show that only 66 per cent of the total was used for lighting purposes and that 34 per cent was used for heat. The increase in the consumption of fuel gas from 19.55 per cent in 1902 to 34 per cent in 1905 is significant, and illustrates quite forcibly the growing popularity of gas for cooking and other household heating purposes. Many of the gas-making companies are offering inducements in the way of lower prices for gas when used for heating purposes, even when drawn from the same mains as the lighting gas, separate meters being installed; and the cleanliness and convenience of gas are not to be questioned. Another reason for the increased percentage of fuel gas is the fact that probably the larger part of the gas output of by-product coke ovens is used for iron and steel making, the ovens being operated in connection with the iron and steel mills. The actual quantity of coal gas used for fuel purposes has increased nearly 150 per cent in three years—from 5,678,000,000 cubic feet in 1902 to 13,636,000,000 cubic feet in 1905.

The following table shows the total quantity of gas sold in 1904 and 1905, by States, with the quantity and percentage used for illuminating and fuel purposes:

Quantity of illuminating and fuel coal gas sold in 1904 and 1905, by States.

1904.

State.	Total sales.	Illuminating.		Fuel.	
		Quantity.	Per cent.	Quantity.	Per cent.
	Cubic feet.	*Cubic feet.*		*Cubic feet.*	
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

Quantity of illuminating and fuel coal gas sold in 1904 and 1905, by States—Continued.

1904.

State.	Total sales.	Illuminating.		Fuel.	
		Quantity.	Per cent.	Quantity.	Per cent.
	Cubic feet.	*Cubic feet.*		*Cubic feet.*	
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

1905.

State.	Total sales.	Illuminating quantity.	Per cent.	Fuel quantity.	Per cent.
Alabama	1,905,498,180	88,178,060	5	1,817,320,120	95
Arkansas	51,914,400	32,893,940	63	19,020,460	37
California	30,474,033	11,463,121	38	19,010,912	62
Colorado	496,695,079	186,837,850	38	309,857,229	62
Connecticut	527,103,580	333,878,920	63	193,224,660	37
Delaware	60,690,000	38,280,500	63	22,409,500	37
Florida, Louisiana, and Mississippi	67,703,000	29,387,000	43	38,316,000	57
Georgia	468,572,850	243,059,500	52	225,513,350	48
Idaho, North and South Dakota, Utah, and Wyoming	108,204,812	40,528,052	37	67,676,760	63
Illinois	1,768,186,332	850,373,945	48	917,812,387	52
Indiana	1,216,172,974	704,757,008	58	511,415,966	42
Indian Territory and Oklahoma	52,194,000	13,834,000	26	38,360,000	74
Iowa	534,747,650	288,383,885	54	246,363,765	46
Kansas	151,847,400	46,598,400	31	105,249,000	69
Kentucky	596,328,520	335,862,264	56	260,466,256	44
Maine	154,068,475	106,969,415	69	47,099,060	31
Maryland and District of Columbia	1,753,770,009	1,713,957,825	98	39,812,184	2
Massachusetts	4,975,461,725	4,489,764,701	90	485,697,024	10
Michigan	3,263,603,059	2,153,938,046	66	1,109,665,013	34
Minnesota	834,691,210	567,219,410	68	267,471,800	32
Missouri	1,672,955,701	872,796,283	52	800,159,418	48
Montana, Nevada, and New Mexico	62,522,700	18,992,720	30	43,529,980	70
Nebraska	65,553,100	31,909,000	49	33,644,100	51
New Hampshire and Vermont	190,765,514	143,596,884	75	47,168,630	25
New Jersey	1,483,032,012	1,144,064,312	77	338,967,700	23
New York	5,004,667,394	4,417,698,676	88	586,968,718	12
North Carolina	58,848,230	35,969,300	61	22,878,930	39
Ohio	4,728,777,755	3,031,002,133	64	1,697,775,622	36
Oregon	18,131,200	10,580,300	58	7,550,900	42
Pennsylvania	3,910,669,305	2,190,416,022	56	1,720,253,283	44
Rhode Island	490,466,400	318,018,020	65	172,448,380	35
South Carolina	116,931,170	74,120,820	63	42,810,350	37
Tennessee	430,175,200	273,772,407	64	156,402,793	36
Texas	166,917,672	60,402,007	36	106,515,665	64
Virginia	420,420,478	322,709,181	77	97,711,297	23
Washington	359,180,276	204,039,265	57	155,141,011	43
West Virginia	129,935,260	126,022,460	97	3,912,800	3
Wisconsin	2,126,338,477	1,265,560,390	60	860,778,087	40
Total	40,454,215,132	26,817,836,022	66	13,636,379,110	34

PRODUCTION OF OIL AND WATER GAS.

Since the manufacture of coke in retort ovens assumed, in 1897, an importance sufficient to be considered an independent industry, the problems regarding the supply of and the demand for the by-products obtained have created a desire for statistical data on these products as produced at gas houses; and as no other bureau of the Federal Government was charged with that duty at that time the Geological Survey undertook the preparation of the special report on the production of gas, coke, tar, and ammonia in 1898, and since 1902 the statistics have been collected each year. Similarly the statistics of coal-gas production have suggested a desire for information as to the production of oil and water gas, and in response to numerous requests the following information has been collected and compiled for this report.

Returns were received from 477 oil and water-gas producing companies, and these show that the total production of water gas in 1905 was 82,959,228,504 cubic feet. Of this quantity 5,547,203,913 cubic feet, or 6.7 per cent, were lost by leakage, etc., leaving 77,412,024,591 cubic feet as the net production obtained and sold. As the quantity of gas made and sold at coal-gas and by-product coke-oven works was 40,454,215,132 cubic feet, it appears that the consumption of water gas and gas made from crude oil was nearly twice as much as that made from coal. It also appears that while the average price of coal gas in 1905 was 81.4 cents per 1,000 cubic feet, that of oil and water gas combined was a fraction of a cent in excess of $1 per 1,000 cubic feet. Still further comparison shows that whereas 66 per cent of the production of coal gas was sold as illuminating gas, 77 per cent of the combined production of oil and water gas was used for this purpose.

The quantity and value of oil and water gas produced in the United States in 1905, by States, are shown in the following table. New York is by far the largest producer, with 37 per cent of the total. Illinois comes second, with 12 per cent of the total, and Pennsylvania third, with 11 per cent

Quantity and value of oil and water gas produced and sold in the United States in 1905, by States.

State.	Number of establishments.	Total quantity of 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.	Price per 1,000 cubic feet.	
		Cubic feet.	*Cubic feet.*			*Cubic feet.*			*Cubic feet.*			*Cubic feet.*
Alabama	2											
Louisana	2	744,991,632	352,349,229	$488,666	$1.38	325,460,504	$450,440	$1.38	677,809,733	$939,106	$1.38	67,181,899
Mississippi	1											
Arkansas	3	72,117,810	39,664,660	62,944	1.59	32,446,740	42,447	1.30	72,111,400	105,391	1.46	6,410
California	53	5,581,217,182	3,792,705,977	3,691,044	.97	1,559,104,387	1,654,558	1.06	5,351,810,364	5,345,602	.99	229,406,818
Colorado	6	268,254,000	95,804,850	121,728	1.27	151,668,171	153,728	1.01	247,473,021	275,456	1.11	20,780,979
Connecticut	17	1,710,251,684	1,134,296,578	1,258,863	1.10	476,617,460	502,535	1.05	1,610,914,038	1,761,398	1.09	99,337,646
Delaware	2											
District of Columbia	2	3,009,307,400	2,207,221,196	2,270,032	1.03	563,486,541	592,710	1.05	2,770,707,737	2,862,742	1.03	238,599,663
Maryland	6											
Florida	9	152,169,400	83,231,606	156,604	1.88	66,110,405	104,602	1.58	149,342,011	261,206	1.74	2,827,389
Georgia	5	376,509,279	179,714,250	204,555	1.13	177,473,150	191,514	1.08	357,187,400	396,069	1.10	19,321,879
Illinois	25	10,331,984,080	6,848,075,406	5,947,088	.86	2,626,206,962	2,283,386	.86	9,474,282,368	8,230,474	.86	857,701,712
Indiana	17	640,642,500	359,816,382	363,393	1.00	230,301,804	218,132	.94	590,118,186	581,525	.98	50,524,314
Iowa	22	831,209,584	440,877,502	525,474	1.19	352,194,388	411,245	1.16	793,071,890	936,719	1.18	38,137,694
Kansas	5	24,701,900	12,063,225	18,977	1.57	12,539,675	17,880	1.42	24,602,900	36,857	1.49	99,000
Kentucky	6	247,252,600	100,397,000	121,669	1.21	123,770,600	88,812	.71	224,167,600	210,481	.93	23,085,000
Maine	3	116,364,000	82,313,170	110,176	1.33	24,618,230	31,935	1.29	106,931,400	142,111	1.32	9,432,600
Massachusetts	33	3,508,309,632	2,919,904,984	2,906,412	.99	457,894,916	471,576	1.03	3,377,799,900	3,377,988	1.00	130,509,732
Michigan	16	841,566,604	318,362,912	304,017	.95	465,861,161	394,763	.85	784,224,073	698,780	.88	57,342,531
Minnesota	8	985,622,000	587,311,990	643,017	1.09	337,223,500	369,776	1.09	924,535,490	1,012,793	1.09	61,086,510
Missouri	8	3,428,602,800	1,602,557,089	1,609,592	1.00	1,601,320,500	1,350,835	.84	3,203,877,589	2,960,427	.92	224,725,211
Nebraska	7	593,830,960	237,449,770	304,143	1.28	318,240,541	398,631	1.25	555,690,311	702,774	1.26	38,140,649
New Hampshire	6	149,858,180	96,011,658	142,802	1.48	42,736,476	63,706	1.49	138,748,134	206,508	1.48	11,110,046
New Jersey	19	5,839,437,175	2,485,491,448	2,665,452	1.07	2,734,855,288	2,877,891	1.05	5,220,346,736	5,543,343	1.06	619,090,439
New York	56	30,952,263,829	25,696,792,789	25,685,762	.99	3,088,930,930	3,226,608	1.04	28,785,723,719	28,912,370	1.00	2,166,540,110

North Carolina	6	97,608,130	61,640,254	93,803	1.52	32,195,076	39,885	1.24	93,835,330	133,688	1.42	3,772,800
South Carolina	2											
North Dakota	1	79,138,000	35,760,100	62,614	1.75	25,403,000	55,821	1.58	71,163,100	118,435	1.66	7,974,900
South Dakota	3											
Ohio	18	759,126,070	475,047,848	417,349	.87	205,335,628	147,472	.71	680,583,476	564,821	.83	78,742,594
Pennsylvania	64	8,686,430,562	7,841,283,727	8,070,667	1.02	659,922,677	779,904	1.18	8,501,206,404	8,850,571	1.04	185,224,158
Rhode Island	6	804,106,000	464,259,200	537,065	1.15	277,829,200	280,381	1.00	742,088,400	817,446	1.10	62,017,600
Tennessee	3	279,300,000	122,080,300	120,391	.98	107,520,000	107,373	.99	229,600,300	227,764	99	49,699,700
Texas	7	321,992,690	92,511,709	141.209	1.51	196,960,719	277,545	1.40	290,472.428	418,754	1.44	31,520,262
Vermont	5	62,775,582	25,766,466	34,786	1.35	33,473,800	41,438	1.23	59,240,266	76,224	1.28	3,535,316
Virginia	4	374,655,700	225,970,087	232,952	1.03	48,928,975	49,251	1.00	274,899,062	282,303	1.02	99,756,638
West Virginia	1											
Wisconsin	10	508,493,435	202,350,575	236,603	1.16	257,492,588	227,257	.88	459,843,163	463,860	1.00	48,650,272
Arizona	2	579,158,104	311,720,492	338,233	1.08	256,096,170	280,281	1.09	567,816,662	618,514	1.08	11,321,442
Nevada	1											
Oklahoma	1											
Oregon	1											
Utah	1											
Washington	2											
Total	477	82,959,228,504	59,531,804,429	59,888,082	1.005	17,880,220,162	18,184,418	1.017	77,412,024,591	78,072,500	1.008	5,547,203,913

PRODUCTION OF COKE.

The total quantity of coke produced in retort or by-product recovery ovens and at gas works in 1905 amounted to 5,751,378 short tons, valued at $18,844,866, against 4,716,049 short tons, valued at $14,693,126 in 1904, and 3,941,282 short tons, valued at $13,634,095 in 1903. Of the total product in 1905, 2,289,030 short tons, or 39.8 per cent, were produced at gas works, and 3,462,348 short tons, or 60.2 per cent, in retort ovens. In 1904 the production of gas-house coke amounted to 2,107,820 short tons, and that of retort-oven coke to 2,608,229 short tons; in 1903 the production of gas-house coke was 2,058,888 short tons, and that of retort-oven coke 1,882,394 short tons. It will be seen from this that of the total increase in 1905 over 1904, 854,119 short tons, or 82.5 per cent, was in the the production of retort-oven coke, and that compared with 1903 the output of retort-oven coke has increased 83.9 per cent, while that of gas-house coke shows a gain of 11.18 per cent.

The total quantity of coal carbonized or coked at gas works and by-product oven plants in 1905 was 8,187,812 short tons, of which 3,558,831 short tons were used at gas works, and 4,628,981 short tons in retort ovens. In 1904 the consumption was nearly equally divided, gas works using 3,485,208 short tons and retort ovens 3,572,949 short tons.

The average price per ton for the coke produced was $3.28 in 1905, against $3.12 in 1904.

Many gas companies are engaged also in the electric-light business, and coke produced at the gas works, as well as a considerable quantity 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 1904 and 1905, 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 1904 and 1905.

1904.

Rank.	State.	Number of establishments.	Quantity.	Value	Value per ton.	Yield of coal in coke.
			Short tons.			*Per cent.*
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
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

Rank of States in production of coke in gas works and by-product ovens in 1904 and 1905—Continued.

1904.

Rank.	State.	Number of establishments.	Quantity.	Value.	Value per ton.	Yield of coal in coke.
			Short tons.			*Per cent.*
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

1905.

Rank.	State.	Number of establishments.	Quantity.	Value.	Value per ton.	Yield of coal in coke.
1	Pennsylvania	30	1,374,815	$3,903,634	$2.84	73.0
2	Massachusetts	44	670,542	2,247,074	3.35	71.3
3	Ohio	40	497,208	1,446,387	2.91	71.6
4	Michigan	42	470,718	1,592,253	3.38	75.0
5	New York	51	423,167	1,335,345	3.15	61.3
6	District of Columbia and Maryland	8	406,764	1,334,266	3.28	75.2
7	Alabama	10	[a] 384,206	1,157,987	3.01	70.8
8	Wisconsin	20	293,759	1,252,106	4.26	74.9
9	New Jersey	16	191,824	643,984	3.35	73.9
10	Minnesota	8	134,670	569,964	4.23	70.6
11	Illinois	41	129,564	487,772	3.76	59.5
12	Missouri	19	124,886	439,920	3.52	64.1
13	West Virginia	6	119,369	415,468	3.48	70.4
14	Indiana	33	90,927	303,354	3.34	60.8
15	Kentucky	12	56,328	183,100	3.25	69.3
16	Iowa	16	39,369	179,533	4.56	63.6
17	Tennessee	8	39,159	135,790	3.47	61.2
18	Connecticut	7	37,958	133,407	3.51	62.5
19	Colorado	5	35,089	140,673	4.01	66.1

[a] In addition 438 tons were produced and unsold, there being no market for it.

Rank of States in production of coke in gas works and by-product ovens in 1904 and 1905—Continued.

1905.

Rank.	State.	Number of establishments.	Quantity.	Value.	Value per ton.	Yield of coal in coke.
			Short tons.			*Per cent.*
20	Rhode Island	3	34,868	$135,018	$3.87	64.8
21	Georgia	9	34,720	101,181	2.91	64.0
22	Virginia	13	32,422	116,879	3.60	58.2
23	Washington	7	28,006	109,032	3.89	68.9
24	New Hampshire and Vermont	7	14,095	74,863	5.31	64.1
25	Texas	9	11,984	54,531	4.55	63.2
26	South Carolina	3	11,823	42,992	3.64	80.8
27	Maine	7	10,746	51,253	4.77	62.7
28	Kansas	7	9,749	35,260	3.62	50.9
29	Idaho, North Dakota, South Dakota, Utah, and Wyoming	8	7,462	42,923	5.75	48.4
30	Florida, Louisiana, and Mississippi	7	6,180	26,313	4.26	60.8
31	North Carolina	6	5,373	29,253	5.44	52.6
32	Nebraska	3	4,916	26,135	5.32	63.5
33	Delaware	3	4,128	12,740	3.09	53.0
34	Montana, Nevada, and New Mexico	4	4,017	26,348	6.55	49.0
35	Arkansas	4	3,894	16,247	4.17	62.5
36	Indian Territory and Oklahoma	5	3,636	16,551	4.55	55.0
37	California	3	1,710	16,384	9.58	53.6
38	Oregon	3	1,327	8,946	6.74	58.5
	Total	527	5,751,378	18,844,866	3.28	70.25

PRODUCTION OF COAL TAR.

Coal tar, as the raw material from which is obtained creosoting oils, aniline dyes, and salts, and innumerable organic chemical compounds and medicinal preparations, is of much more economic importance in some of the European countries than it is in the United States. This country is considerably in the rear, particularly when compared with Germany, in the development of chemical industries based on coal tar, the products of which are imported to the value of several million dollars each year. At the present time coal-tar manufacture in the United States is confined principally to the production of creosote and of tars and tar pitches suitable for roofing papers, paving materials, etc. With the continued development of the retort-oven coking industry, however, and an assured supply of coal tar, there is every reason to believe that chemical industries dependent upon tar as a raw material will be established. The lack of such an outlet for one of the principal by-products of retort-oven coke manufacture is in part responsible for the fact that the construction of by-product oven plants has not been more energetically pushed in this country.

The statistics collected for this report show that in 1905 the total production of coal tar at gas works and retort-oven plants in the United States was 80,022,043 gallons, valued at $2,176,944, against 69,498,085 gallons, valued at $2,114,421, in 1904. From this it appears that while the quantity of tar produced increased 10,522,958 gallons, or 15 per cent, the value increased only $62,523, or less than 3 per cent. When compared with the statistics for 1903 a still larger difference is shown, for while the production in 1905 was over 17,000,000 gallons, or more than 25 per cent in excess of that of 1903, the value shows a decrease of $23,000. The average price per gallon at the works has declined from 3.49 cents in 1903, to 3.04 cents in 1904, and to 2.72 cents in 1905.

As shown in the footnotes to the following tables, there were about 80,000 gallons unmarketed in 1904, and 160,000 gallons in 1905. The surplus was not large in either case, but it was sufficient to indicate a production in excess of the market requirements, the result of which is naturally shown in reduced values.

The yield of tar per ton of coal consumed in 1905 ranged from 7.3 gallons in North Carolina to 13.2 gallons in Rhode Island. Prices ranged from 1.9 cents per gallon in Michigan (in which State a surplus of 53,526 gallons was reported) to 10 cents per gallon in Oregon.

The following table exhibits the production of coal tar in 1904 and 1905, by States, arranged according to their producing importance:

Rank of States in coal-tar production in 1904 and 1905.

1904.

Rank.	State.	Quantity.	Value.	Value per gallon.	Yield per ton of coal.
		Gallons.		*Cents.*	*Gallons.*
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	6,867,555	214,717	3.1	11.71
5	Michigan	4,957,578	124,792	2.5	10.12
6	Alabama	4,354,115	105,372	2.42	8.32
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	496,682	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	150,390	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.

Rank of States in coal-tar production in 1904 and 1905—Continued.

1905.

Rank.	State.	Number of establishments.	Quantity.	Value.	Value per gallon.	Yield per ton of coal.
			Gallons.		*Cents.*	*Gallons.*
1	Pennsylvania	30	14,249,781	$319,201	2.24	7.57
2	Massachusetts	45	10,017,517	285,666	2.85	10.65
3	Ohio	38	8,479,198	270,325	3.19	12.23
4	New York	51	7,349,569	189,866	2.6	10.65
5	Michigan	41	[a] 5,958,602	116,809	1.9	9.6
6	Alabama	10	[b] 4,592,516	128,271	2.8	8.5
7	District of Columbia and Maryland	8	4,155,460	87,512	2	7.7
8	Wisconsin	20	3,905,217	94,305	2.4	9.96
9	New Jersey	16	2,774,725	84,243	3	10.69
10	Missouri	19	2,486,575	86,515	3.48	12.8
11	Illinois	41	2,415,023	49,714	2.05	11.09
12	Minnesota	8	2,111,083	54,823	2.6	11.07
13	West Virginia	6	1,766,066	50,542	2.8	10.42
14	Indiana	32	[c] 1,712,397	44,198	2.58	11.45
15	Kentucky	12	959,293	17,942	1.87	11.8
16	Tennessee	8	721,411	29,663	4	11.3
17	Georgia	9	712,799	24,604	3.45	13.15
18	Connecticut	7	712,328	35,980	5	11.64
19	Rhode Island	3	710,069	20,400	2.8	13.2
20	Colorado	5	698,527	26,758	3.8	13.15
21	Virginia	13	691,530	21,152	3.06	12.4
22	Iowa	16	633,598	14,775	2.3	10.24
23	Washington	7	465,380	32,268	6.9	11.45
24	New Hampshire and Vermont	7	265,556	13,177	4.96	12.07
25	Texas	10	236,341	15,140	6.4	12.35
26	Maine	7	212,445	9,985	4.7	12.4
27	Kansas	7	205,690	10,898	5.3	10.74
28	South Carolina	3	158,361	5,315	3.3	10.8
29	Montana, Nevada, and New Mexico	4	89,226	3,496	3.9	10.89
30	Florida, Louisiana, and Mississippi	7	87,226	5,710	6.5	8.6
31	Idaho, North Dakota, South Dakota, Utah, and Wyoming.	6	[d] 85,458	6,830	8	7.8
32	Nebraska	3	82,393	2,426	2.9	10.64
33	Delaware	3	76,606	2,725	3.557	9.9
34	North Carolina	6	74,503	4,355	5.8	7.3
35	Arkansas	4	66,900	3,677	5.5	10.74
36	Indian Territory and Oklahoma	5	54,002	3,323	6.15	8.2
37	California	3	27,220	2,212	8	8.5
38	Oregon	3	21,452	2,145	10	9.4
	Total	521	80,022,043	2,176,944	2.72	9.79

[a] In addition 53,526 gallons were produced and unsold, there being no market for it.
[b] In addition 52,000 gallons were produced and unsold, there being no market for it.
[c] In addition 12,914 gallons were produced and unsold, there being no market for it.
[d] In addition 43,725 gallons were produced and unsold, there being no market for it.

PRODUCTION OF WATER-GAS TAR.

The following table gives approximately the amount of water-gas tar produced and sold in the United States in 1905 and the price received for it at the works. At many of the plants there is no market for this product, and it is consumed at the works, no record being kept of the output. Where companies produce both coal and water gas, the water-gas tar, if sold at all, brings a lower price per gallon than the coal-gas tar. While there is a market in many of the States for coal-gas tar, much of it is also consumed by the producing companies, particularly when the company is a producer of both coal and water gas. The production and sale of water-gas tar in the United States is so small it is scarcely worth consideration in a report.

Quantity and value of tar produced and sold at water-gas and crude-oil works in the United States in 1905.

State.	Total quantity.	Total value.	Price per gallon.
	Gallons.		*Cents.*
Arkansas	3,600	$360	10
California	1,848,372	65,731	3.5
Colorado and Oregon	232,031	14,202	6.1
Connecticut	160,250	3,045	1.9
Florida	35,807	583	1.6
Georgia and South Carolina	14,254	577	4
Illinois	5,000	300	6
Iowa	146,856	3,645	2.5
Kansas	1,500	150	10
Louisiana and Mississippi	474,174	14,550	3.1
Maryland	10,000	1,000	10
Massachusetts	1,380,726	38,454	2.7
Minnesota	283,099	8,493	3
Nebraska	321,967	7,097	2.2
Missouri	6,200	320	5
New Hampshire	14,332	143	1
New York	3,990,090	79,736	2
Ohio	600	30	5
Pennsylvania	277,274	5,621	2
Texas	23,900	1,195	5
Vermont	379	20	5.3
Total	[a] 9,230,411	245,252	2.66

[a] In addition 2,274,891 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 1905, out of a total of 529 establishments, the production of ammonia was reported by but 115. In 1904 ammonia production was reported by 117 establishments out of a total of 534, and in 1903 by 115 out of a total of 528. The 115 companies making returns in 1905 reported a total production of 46,986,268 gallons of ammonia liquor, valued at $1,728,254, and 38,663,682 pounds of sulphate, valued at $997,452, against 52,220,484 gallons of liquor, worth $1,487,196, and 28,225,210 pounds of sulphate, valued at $771,995, in 1904. The comparatively higher value of the liquor sold in 1905 was due in large part to its greater average strength, for in 1904 the 52,220,484 gallons reduced to anhydrous ammonia represented an equivalent of only 19,750,032 pounds NH_3, while the 46,986,268 gallons of liquor produced in 1905 was equivalent to 22,455,857 pounds NH_3. The average price of the liquor was 7.7 cents per pound of NH_3 in 1905 and 7.5 cents per pound in 1904.

The total quantity of coal carbonized at works reporting a production of ammonia in 1905 was 7,194,910 short tons, of which 6,298,783 tons were consumed at works producing ammonia liquor and 896,127 tons at works reporting their production in the form of sulphate.

In 1904 the quantity of coal carbonized was 6,115,588 short tons, of which 5,230,991 tons were consumed at works reporting ammonia liquor production, and 884,597 at plants making sulphate of ammonia. The average yield of sulphate per ton of coal was 43 pounds in 1905 and 32 pounds in 1904. The average yield of ammonia liquor, expressed in HN_3, was 3.57 pounds in 1905 against 3.78 pounds in 1904.

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. In accordance with the method adopted in the preceding reports, 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 1904 and 1905:

Production and value of ammoniacal liquor at gas and by-product coke works of the United States in 1904 and 1905.

1904.

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.*					
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

Production and value of ammoniacal liquor at gas and by-product coke works of the United States in 1904 and 1905—Continued.

1904.

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.*					
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
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
5,648	60,873	48.00	16.70	63,537	64.79	5,479
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
5,230,991	52,220,484	....	....	19,750,032	....	1,487,196

Production and value of ammoniacal liquor at gas and by-product coke works of the United States in 1904 and 1905—Continued.

1905.

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.*					
197,577	8,227,916	2.78	0.97	497,275	3.76	$18,299
7,470	815,740	3.5	1.22	62,098	4.73	2,855
18,189	636,615	4.00	1.39	55,306	5.40	1,273
30,324	645,646	4.8	1.67	67,389	6.48	5,165
11,551	349,141	4.86	1.69	36,878	6.56	1,018
58,945	1,866,517	5.00	1.74	202,984	6.75	9,219
44,126	1,685,918	5.99	2.08	219,591	8.07	11,091
66,810	1,646,584	6.00	2.09	215,085	8.10	10,373
139,819	4,816,260	6.9	2.40	722,439	9.31	54,183
39,605	1,395,940	7.00	2.44	212,445	9.45	7,277
147,000	46,853	7.2	2.51	7,350	9.72	515
39,102	1,206,336	7.23	2.52	189,621	9.78	7,564
42,013	1,680,502	8.00	2.78	291,987	10.80	12,604
256,797	9,082,653	8.62	3.00	1,702,429	11.64	66,303
8,728	81,507	9.4	3.27	16,658	12.69	880
34,636	440,158	10.00	3.48	95,726	13.50	9,227
12,523	43,192	15.2	5.29	14,275	20.53	928
235,055	2,389,859	16.00	5.57	831,674	21.60	38,533
10,625	37,517	32.00	11.14	26,121	43.20	1,151
3,692	7,925	35.52	12.36	6,122	47.95	429
5,595	12,300	38.00	13.22	10,163	51.29	620
16,304	36,205	40.00	13.92	31,498	53.99	2,471
14,022	35,056	44.00	15.31	33,544	59.39	4,319
34,716	58,767	48.00	16.70	61,338	64.79	3,394
20,507	18,250	51.64	17.97	20,497	69.72	1,694
13,426	52,556	52.00	18.09	59,421	70.19	3,565
13,944	36,435	53.2	18.51	42,151	71.82	2,180
15,255	56,552	54.00	18.79	66,414	72.89	5,313
2,578	3,200	56.00	19.48	3,896	75.58	438
3,512	6,965	56.4	19.62	8,792	76.13	615
17,168	38,785	58.00	20.18	48,918	78.29	2,835
387,763	1,192,976	60.00	20.87	1,556,088	80.99	124,303
145,515	412,559	60.2	20.94	539,925	81.25	44,019
6,828	14,596	62.00	21.57	19,677	83.69	1,082
27,880	51,823	63.12	21.96	71,124	85.20	4,809
8,797	27,261	64.00	22.26	37,927	86.39	2,845
42,500	162,870	64.56	22.46	228,628	87.14	20,577
11,516	29,748	65.00	22.61	42,038	87.74	2,943
80,720	294,097	65.48	22.78	418,720	88.39	41,872
65,925	170,011	66.48	23.13	245 772	89.74	16,098
52,444	93,902	66.66	23.19	136,100	89.98	9,527
142,262	267,201	68.8	23.94	399,799	92.89	30,031
59,836	174,407	70.00	24.35	265,426	94.48	24,552
864,966	1,108,205	70.7 71.4 72.00	24.60 24.84 25.05	1,731,023	95.45 96.38 97.19	135,474

Production and value of ammoniacal liquor at gas and by-product coke works of the United States in 1904 and 1905—Continued.

1905.

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.*					
		72.44	25.20		97.78	
240,426	709,350	73.00	25.40	1,156,733	98.55	$90,393
		76.72	26.69		103.56	
		78.00	27.14		105.30	
558,717	1,425,076	80.09	27.83	2 587,567	107.98	246,813
		84.96	29.56		114.69	
		85.56	29.77		115.50	
1,091,006	1,388,615	92.4	32.15	2,700,849	124.74	241,049
		96.08	33.43		129.71	
		100.00	34.79		134.99	
950,068		102.28	35.58		138.05	
	2,005,730	102.72	35.74	4,458,376	138.67	405,536
		113.44	39.47		153.14	
6,298,783	46,986,268	....	....	22,455,857	....	1,728,254

Production of ammonia in 1904 and 1905, by States.

1904.

State.	Coal carbonized.	Ammonia liquor produced.	Equivalent to anhydrous ammonia (NH_3).
	Short tons.	*Gallons.*	*Pounds.*
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	11,235	24,626	31,060
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	5,230,991	52,220,484	19,750,032
Quantity of ammonia produced and sold as sulphate (pounds)		28,225,210	

Production of ammonia in 1904 and 1905, by States—Continued.

1905.

State.	Coal carbonized.	Ammonia liquor produced.	Equivalent to anhydrous ammonia (NH_3).
	Short tons.	*Gallons.*	*Pounds.*
Alabama and Georgia	559,837	425,859	230,207
Colorado and Washington	58,238	1,241,546	243,756
Connecticut and Rhode Island	55,996	1,793,070	262,786
Delaware, Maryland, and District of Columbia	540,375	2,601,484	2,234,627
Illinois	123,372	288,109	312,926
Indiana	84,948	26,774	33,769
Kentucky	69,243	2,345,918	310,934
Maine and New Hampshire	26,967	283,394	69,586
Massachusetts	856,823	2,184,760	774,715
Michigan	556,621	1,574,608	2,654,323
Minnesota	179,073	482,879	771,900
Missouri	166,646	5,189,464	784,433
New Jersey	239,582	2,030,703	1,165,550
New York	626,036	10,292,359	2,787,317
Ohio	604,613	8,722,442	1,117,271
Pennsylvania	1,861,203	5,095,544	5,880,172
Tennessee	58,710	415,206	91,794
Virginia and West Virginia	176,398	1,073,102	1,002,058
Wisconsin	350,229	919,047	1,727,733
Total	[a] 7,194,910	46,986,268	22,455,857
Quantity of ammonia produced and sold as sulphate (pounds)		38,663,682	

[a] Includes 896,127 tons of coal carbonized at works which made sulphate of ammonia.

Production of ammonia at gas and by-product coke works of the United States in 1904 and 1905.

	1904.	1905.
Coal carbonized at works which produced and sold ammonia liquor.short tons.	5,230,991	6,298,783
Coal carbonized at works which produced sulphate of ammonia...do...	884,597	896,127
Total coal carbonized...do...	6,115,588	7,194,910
Ammonia liquor produced and sold...gallons..	52,220,484	46,986,268
Equivalent to anhydrous ammonia (NH_3)...pounds..	19,750,032	22,455,857
Equivalent to sulphate of ammonia...do...	76,630,124	87,128,725
Ammonia produced and sold as sulphate...do...	28,225,210	38,663,682
Value received for ammonia liquor	$1,487,196	$1,728,254
Value received for sulphate of ammonia	771,995	997,452
Total value received	2,259,191	2,725,706

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 1904 and 1905, by States. The aggregate value of these products in 1905 was $56,684,972, as compared with $51,157,736 in 1904, $47,830,600 in 1903, and $43,869,440 in 1902.

Production of coal gas and by-products in the United States in 1904 and 1905, by States.

1904.

State.	Coal gas produced and used for illuminating and fuel purposes.	By-products.			Gas unaccounted for.
		Tar.	Anhydrous ammonia, NH_3.	Coke.	
	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	....	31,060	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	19,750,032	4,716,049	2,856,848,400
Sulphate of ammonia	....	....	28,225,210	....	....

Production of coal gas and by-products in the United States in 1904 and 1905, by States—Continued.

1905.

State.	Coal gas produced and used for illuminating and fuel purposes.	By-products.			Gas unaccounted for.
		Tar.	Anhydrous ammonia, NH_3	Coke.	
	Cubic feet.	*Gallons.*	*Pounds.*	*Short tons.*	*Cubic feet.*
Alabama	1,905,498,180	4,592,516	230,207	384,206	53,281,600
Georgia	468,572,850	712,799		34,720	12,075,750
Arkansas	51,914,400	66,900	....	3,894	1,500,000
California	30,474,033	27,220	....	1,710	160,095
Colorado	496,695,079	698,527	243,756	35,089	37,907,421
Washington	359,180,276	465,380		28,006	36,460,784
Connecticut	527,103,580	712,328	262,786	37,958	42,679,300
Rhode Island	490,466,400	710,069		34,868	45,825,100
Delaware	60,690,000	76,606	2,234,627	4,128	8,867,200
District of Columbia and Maryland	1,753,770,009	4,155,460		406,764	44,928,666
Florida, Louisiana, and Mississippi	67,703,000	87,226	....	6,180	15,002,000
Idaho, North and South Dakota, Utah, and Wyoming	108,204,812	85,458	....	7,462	27,334,824
Illinois	1,768,186,332	2,415,023	312,926	129,564	202,423,328
Indiana	1,216,172,974	1,712,397	33,769	90,927	117,532,469
Indian Territory and Oklahoma	52,194,000	54,002	....	3,636	....
Iowa	534,747,650	633,598	....	39,369	43,427,850
Kansas	151,847,400	205,690	....	9,749	20,280,600
Kentucky	596,328,520	959,293	310,934	56,328	94,285,827
Maine	154,068,475	212,445	69,586	10,746	22,350,305
New Hampshire	190,765,514	265,556		14,095	22,071,586
Vermont			....		
Massachusetts	4,975,461,725	10,017,517	774,715	670,542	222,242,311
Michigan	3,263,603,059	5,958,602	2,654,323	470,718	176,990,336
Minnesota	834,691,210	2,111,083	771,900	134,670	48,129,190
Missouri	1,672,955,701	2,486,575	784,433	124,886	169,239,499
Montana, Nevada, and New Mexico	62,522,700	89,226	....	4,017	7,820,650
Nebraska	65,553,100	82,393	....	4,916	9,418,000
New Jersey	1,483,032,012	2,774,725	1,165,550	191,824	88,320,888
New York	5,004,667,394	7,349,569	2,787,317	423,167	476,935,569
North Carolina	58,848,230	74,503	....	5,373	14,910,670
Ohio	4,728,777,755	8,479,198	1,117,271	497,208	575,147,235
Oregon	18,131,200	21,452	....	1,327	585,000
Pennsylvania	3,910,669,305	14,249,781	5,880,172	1,374,815	143,841,319
South Carolina	116,931,170	158,361	....	11,823	16,236,500
Tennessee	430,175,200	721,411	91,794	39,159	93,540,900
Texas	166,917,672	236,341	....	11,984	10,370,118
Virginia	420,420,478	691,530	1,002,058	32,422	93,380,992
West Virginia	129,955,260	1,766,066		119,369	33,110,000
Wisconsin	2,126,338,477	3,905,217	1,727,733	293,759	171,978,023
Total	40,454,215,132	80,022,043	22,455,857	5,751,378	3,200,591,905
Sulphate of ammonia	....	....	38,663,082	....	....

Value of gas and by-products produced in the United States in 1904, by States.

State.	Total value of illuminating and fuel gas.	Value of by-products. Tar.	Ammonia liquor and sulphate of ammonia.	Coke.	Total.	Total value of all products.
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	102,858	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
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

Value of coal gas and by-products produced in the United States in 1905, by States.

State.	Total value of illuminating and fuel coal gas.	Value of by-products.				Total value of all products.
		Tar.	Ammonia liquor and sulphate of ammonia.	Coke.	Total.	
Alabama	$429,817	$128,271	$253,453	$1,157,987	$1,665,496	$2,586,451
Georgia	491,138	24,604		101,181		
Arkansas	72,026	3,677	....	16,247	19,924	91,950
California	47,793	2,212	....	16,384	18,596	66,389
Colorado	556,917	26,758	9,289	140,673	318,020	1,334,040
Washington	459,103	32,268		109,032		
Connecticut	579,553	35,980	8,868	133,407	333,673	1,461,859
Rhode Island	548,633	20,400		135,018		
Delaware	61,226	2,725	434,385	12,740	1,871,628	2,529,212
District of Columbia and Maryland	596,358	87,512		1,334,266		
Florida, Louisiana, and Mississippi	90,989	5,710	....	26,313	32,023	123,012
Idaho, North and South Dakota, Utah, Wyoming	166,705	6,830	....	42,923	49,753	216,458
Illinois	1,912,868	49,714	22,956	487,772	560,442	2,473,310
Indiana	1,169,947	44,198	22,630	303,354	370,182	1,540,129
Indian Territory and Oklahoma	55,792	3,323	....	16,551	19,874	75,666
Iowa	633,557	14,775	....	179,533	194,308	827,865
Kansas	194,310	10,898	....	35,260	46,158	240,468
Kentucky	539,724	17,942	15,495	183,100	216,537	756,261
Maine	212,257	9,983	3,578	51,253	152,854	620,651
New Hampshire and Vermont	255,540	13,177		74,863		
Massachusetts	3,574,116	285,666	377,260	2,247,074	2,910,000	6,484,116
Michigan	2,325,377	116,809	271,333	1,592,253	1,980,395	4,305,772
Minnesota	842,599	54,823	59,724	569,964	684,511	1,527,110
Missouri	1,556,117	86,515	56,597	439,920	583,032	2,139,149
Montana, Nevada, New Mexico	114,953	3,496	....	26,348	29,844	144,797
Nebraska	83,563	2,426	....	26,135	28,561	112,124
New Jersey	1,585,683	84,243	96,752	643,984	824,979	2,410,662
New York	5,090,057	189,866	171,946	1,335,345	1,697,157	6,787,214
North Carolina	86,011	4,355	....	29,253	33,608	119,619
Ohio	3,280,672	270,325	88,243	1,446,387	1,804,955	5,085,627
Oregon	39,675	2,145	....	8,946	11,091	50,766
Pennsylvania	2,268,505	319,201	620,068	3,903,634	4,842,903	7,111,408
South Carolina	159,709	5,315	....	42,992	48,307	208,016
Tennessee	434,718	29,663	5,135	135,790	170,588	605,306
Texas	253,566	15,140	....	54,531	69,671	323,237
Virginia	485,368	21,152	86,530	116,879	690,571	1,278,794
West Virginia	102,855	50,542		415,468		
Wisconsin	1,579,659	94,305	121,464	1,252,106	1,467,875	3,047,534
Total	32,937,456	2,176,944	2,725,706	18,844,866	23,747,516	56,684,972

IMPORTS OF COAL-TAR PRODUCTS.

There is little to add to what has previously been stated with regard to the slight progress in the manufacture of chemical products from coal tar which has been made in the United States. With an average annual production exceeding 60,000,000 gallons of coal tar (over 80,000,000 gallons in 1905), this country is depending almost entirely upon Europe (principally Germany) for the coal-tar chemical products, and is importing millions of dollars worth of aniline colors and salts, coal-tar medicinal products, etc., while the domestic manufacture is restricted largely to the production of creosote oils, and of tars and pitches used in the manufacture of roofing paper and for paving materials. The coal tar produced in this country in 1902 was worth at first hand $1,873,966. In 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 1903 was $2,199,969, and in 1904, $2,114,421. In 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; total $8,725,518. In 1905 the value of the coal tar produced in this country was $2,176,944; the imports, with duty added, were valued at $10,201,601. A conservative estimate would place the total value of these imports in the wholesale markets of this country at $12,000,000 in each of the last three years.

The following table shows the value of the coal-tar products imported into the United States and the duty paid thereon in each year since 1896, inclusive:

Coal-tar products imported into the United States, 1896–1905.

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 [a]	$138,013	Free.	$994,395	Free.	$662,459	Free.	$2,918,333	$729,583
1897 [a]	201,980	Free.	1,023,425	Free.	812,884	Free.	3,163,182	790,796
1898 [a]	28,688	$6,794	886,349	Free.	1,087,704	Free.	3,723,288	1,098,532
1899 [a]	57,192	18,536	700,786	Free.	743,130	Free.	3,900,099	1,170,030
1900 [a]	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
1905	2,214	923	625,491	Free.	789,052	Free.	5,673,242	1,701,973

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 [a]					$4,713,200	$729,583
1897 [a]					5,201,471	790,796
1898 [a]	$134,416	$26,883	$228,037	Free.	6,088,482	1,132,209
1899 [a]	221,101	44,220	393,602	Free.	6,015,910	1,232,786
1900 [a]	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
1905	768,556	153,711	486,439	Free.	8,344,994	1,856,607

[a] Fiscal years to 1900, inclusive.

statistics of the quantity of gas consumed, and next year this will be undertaken. The adoption of this method will make it inconvenient, if not impossible, to refer back and directly compare previous results; but the method will give such figures in the future that a more direct knowledge will be obtained of the capacity of gas areas to maintain a commercial supply of gas for a certain number of years.

The endeavor will be made to collect and publish statistics showing the total acreage which is held by natural gas companies and the acreage which is being operated by them, with the total quantity of gas consumed in the different States. It is almost impossible to procure exact figures as the quantity of gas produced from any particular district, owing to the fact that gas wells from different fields are connected to the main pipe lines and the gas is only measured where consumed.

PRODUCTIVE AREAS.

The known main productive areas of natural gas in the United States are in connection with the great oil fields. In the Appalachian field this area extends along the western slope of the Appalachian Mountains from New York State into Kentucky and Tennessee, with strong probabilities that the future will see it extended into the northern part of Alabama and possibly into Mississippi. The gas is produced from the same porous sandstone and limestone rocks in which the oil is found. Generally speaking, these rocks contain three fluids—salt water, petroleum, and natural gas. The difference in weight causes these fluids to arrange themselves with the salt water below, the oil above the water, and with the gas filling the higher portions of the rock reservoirs. Experience has shown that in the older or lower sandstone beds of the Appalachian field the area of sand rock which is completely saturated by salt water is much less than in the upper or younger sandstone beds. This condition causes the accumulations of oil to be at or near the lowest points of the rock, and leaves large areas of the higher portions of the rock which are completely filled with natural gas.

The gas-producing area of western Ohio and Indiana derives its gas from the Trenton limestone. This bed has horizons within it which are porous and in which are accumulations of salt water, oil, and gas. The quantity of salt water throughout this field is very plentiful and appears to be capable of advancing and occupying all the space as soon as the expansive force of the gas has been relieved by the opening of gas wells, thereby cutting off the source of further supplies of gas.

In Kansas, Oklahoma, and Indian Territory large and prolific gas fields are being opened up within the oil-bearing formations of that region. This gas is produced from sand rock in all respects similar to that of the Appalachian field, with the probabilities of an extensive and continuous supply.

The great oil fields of Texas and California do not produce natural gas in proportion to their oil production. California, which produced in 1905 a greater quantity of petroleum than any other State of the Union, stands ninth in the list of States in production of natural gas. This is probably caused by the fact that the oil-producing formations of California have been much tilted and are often faulty, which condition has caused the formations of vents and cracks, through which large quantities of natural gas have escaped into the atmosphere.

PRODUCTION.

In the following table is shown the value of the natural gas produced in the separate States of the United States from 1882 to 1905. The total value of this production has amounted to the sum of $426,745,206 in the twenty-four years that this natural resource has been put to commercial use. From the beginning of the industry in 1882 to the year 1888 there was a rapid increase in the value of the gas used each year. From the year 1888 to the year 1896 there was a gradual falling off in the total value each year. This reduction was due principally to the decrease in the States of Pennsylvania and Ohio. From the year 1896 to the present time the value of the gas produced each year has increased rapidly, until it now amounts to $41,562,855.

In the following table is given the approximate value of natural gas produced and sold in the United States from 1882 to 1905, by States:

Approximate value of natural gas produced in the United States, 1882–1905, by States.

State.	1882.	1883.	1884.	1885.	1886.	1887.
Pennsylvania	$75,000	$200,000	$1,100,000	$4,500,000	$9,000,000	$13,749,500
New York	....	....	....	196,000	210,000	333,000
Ohio	....	....	....	100,000	400,000	1,000,000
West Virginia	....	....	....	40,000	60,000	120,000
Illinois	....	....	....	1,200	4,000	....
Indiana	....	....	....	....	300,000	600,000
Kansas	....	....	....	....	6,000	....
Missouri	....	....	....	....	....	....
California	....	....	....	....	....	....
Kentucky and Tennessee	....	....	....	....	....	....
Texas and Alabama	....	....	....	....	....	....
Arkansas and Wyoming	....	....	....	....	....	....
Utah	....	....	....	....	....	....
Colorado	....	....	....	....	....	....
South Dakota	....	....	....	....	....	....
Indian Territory and Oklahoma	....	....	....	....	....	....
Louisiana	....	....	....	....	....	....
Other	140,000	275,000	360,000	20,000	32,000	15,000
Total	215,000	475,000	1,460,000	4,857,200	10,012,000	15,817,500

State.	1888.	1889.	1890.	1891.	1892.	1893.
Pennsylvania	$19,282,375	$11,593,989	$9,551,025	$7,834,016	$7,376,281	$6,488,000
New York	332,500	530,026	552,000	280,000	216,000	210,000
Ohio	1,500,000	5,215,669	4,684,300	3,076,325	2,136,000	1,510,000
West Virginia	120,000	12,000	5,400	35,000	70,500	123,000
Illinois	....	10,615	6,000	6,000	12,988	14,000
Indiana	1,320,000	2,075,702	2.302,500	3,942,500	4,716,000	5,718,000
Kansas	....	15,873	12,000	5,500	40,795	50,000
Missouri	....	35,687	10,500	1,500	3,775	2,100
California	....	12,680	33,000	30,000	55,000	62,000
Kentucky and Tennessee	....	2,580	30,000	38,993	43,175	68,500
Texas and Alabama	....	1,728	....	....	100	50
Arkansas and Wyoming	....	375	....	250	100	100
Utah	....	....	....	....	....	500
Colorado	....	....	....	....	....	....
South Dakota	....	....	....	....	....	....
Indian Territory and Oklahoma	....	....	....	....	....	....
Louisiana	....	....	....	....	....	....
Other	75,000	1,600,175	1,606,000	250,000	200,000	100,000
Total	22,629,875	21,107,099	18,792,725	15,500,084	14,870,714	14,346,250

Approximate value of natural gas produced in the United States, 1882–1905, by States—Continued.

State.	1894.	1895.	1896.	1897.	1898.	1899.
Pennsylvania	$6,279,000	$5,852,000	$5,528,610	$6,242,543	$6,806,742	$8,337,210
New York	219,000	241,530	256,000	200,076	229,078	294,593
Ohio	1,276,100	1,255,700	1,172,400	1,171,777	1,488,308	1,866,271
West Virginia	395,000	100,000	640,000	912,528	1,331,023	2,335,864
Illinois	15,000	7,500	6,375	5,000	2,498	2,067
Indiana	5,437,000	5,203,200	5,043,635	5,009,208	5,060,969	6,680,370
Kansas	86,600	112,400	124,750	105,700	174,640	332,592
Missouri	4,500	3,500	1,500	500	145	290
California	60,350	55,000	55,682	50,000	65,337	86,891
Kentucky and Tennessee	89,200	98,700	99,000	90,000	103,133	125,745
Texas and Alabama	50	20	....	....	765	8,000
Arkansas and Wyoming	100	100	60	40	....	....
Utah	500	20,000	20,000	15,050	7,875	....
Colorado	12,000	7,000	4,500	4,000	3,300	1,480
South Dakota	....	....	....	....	....	3,500
Indian Territory and Oklahoma	....	....	....	....	....	....
Louisiana	....	....	....	....	....	....
Other	50,000	50,000	50,000	20,000	20,000	....
Total	13,954,400	13,006,650	13,002,512	13,826,422	15,296,813	20,074,873

State.	1900.	1901.	1902.	1903.	1904.	1905.
Pennsylvania	$10,215,412	$12,688,161	$14,352,183	$16,182,834	$18,139,914	$19,197,336
New York	335,367	293,232	346,471	493,686	522,575	623,251
Ohio	2,178,234	2,147,215	2,355,458	4,479,040	5,315,564	5,721,462
West Virginia	2,959,032	3,954,472	5,390,181	6,882,359	8,114,249	10,075,804
Illinois	1,700	1,825	1,844	3,310	4,745	7,223
Indiana	7,254,539	6,954,566	7,081,344	6,098,364	4,342,409	3,094,134
Kansas	356,900	659,173	824,431	1,123,849	1,517,643	2,261,836
Missouri	547	1,328	2,154	7,070	6,285	7,390
California	79,083	67,602	120,648	104,521	114,195	133,696
Kentucky and Tennessee	286,243	270,871	[a] 365,656	[a] 390,601	[a] 322,404	[a] 237,590
Texas and Alabama	20,000	18,577	14,953	13,851	[b] 14,082	[b] 14,409
Arkansas and Wyoming	....	....	....	[c] 2,460	[c] 6,515	[c] 21,135
Utah	....	....	....	....	....	....
Colorado	1,800	1,800	1,900	14,140	14,300	20,752
South Dakota	9,817	7,255	10,280	10,775	12,215	15,209
Indian Territory and Oklahoma	....	....	360	1,000	49,665	130,137
Louisiana	....	....	....	....	....	1,500
Other	....	....	....	....	....	....
Total	23,698,674	27,066,077	30,867,863	35,807,860	38,496,760	41,562,855

[a] Includes small production in Tennessee.
[b] Includes Alabama.
[c] Includes Wyoming.

CONSUMPTION.

In the following table is shown the value of the natural gas consumed in the separate States of the United States during the last five years. By comparison of this table with the previous table it will be found that West Virginia, Pennsylvania, Kansas, Oklahoma, and Indian Territory have each produced more gas than they consumed, while the States of New York and Ohio have drawn heavily upon other States for their total consumption. The remaining States have generally consumed only what gas was produced within their borders.

Value of natural gas consumed in the United States, 1901–1905, by States.

State.	1901.	1902.	1903.	1904.	1905.
Pennsylvania	$11,785,996	$13,942,783	$16,060,196	$17,205,804	$19,237,218
Indiana	[a] 6,276,119	[a] 6,710,080	[a] 5,915,367	[a] 4,282,409	[a] 3,056,634
Ohio	4,119,059	4,785,766	7,200,867	9,393,843	10,396,633
West Virginia	2,244,758	2,473,174	3,125,061	3,383,515	3,586,608
New York	1,694,925	1,723,709	1,944,667	2,222,980	2,434,894
Kansas	659,173	824,431	1,123,849	1,517,643	2,265,945
Kentucky and Tennessee	187,660	255,781	280,726	268,564	237,590
California	67,602	120,648	101,521	114,195	133,696
Texas and Alabama	18,577	14,953	13,851	14,082	14,409
South Dakota	7,255	10,280	10,775	12,215	15,200
Missouri	1,328	2,154	7,070	6,285	7,390
Colorado	1,800	1,900	14,140	14,300	20,752
Illinois	1,825	1,841	3,310	4,745	7,223
Indian Territory and Oklahoma	....	360	1,000	49,665	126,028
Arkansas and Wyoming	....	....	2,460	6,515	21,135
Louisiana	....	....	....	....	1,500
Total	27,066,077	30,867,863	35,807,860	38,496,760	41,562,855

[a] A portion of this was consumed in Chicago, Ill.

VALUE OF NATURAL GAS CONSUMED AND VALUE OF OTHER FUEL DISPLACED IN 1905, BY STATES.

In the first column of the following table is given the number of persons, firms, and corporations reported from different States. This is less for the year 1905 than either of the two preceding years, being 2,139 for 1905 as against 2,347 for the year 1904 and 2,329 for the year 1903.

The third column in the table shows the estimated value of wood and coal displaced by natural gas in 1905, which amounted to $49,690,918, or $8,128,063 more than was paid for the natural gas.

The general average price of natural gas to the consumers is very close to 16 cents per thousand cubic feet at a pressure of 4 ounces above the atmosphere. The greater portion of the domestic consumption is furnished at between 18 and 25 cents per thousand cubic feet.

Value of natural gas consumed in the United States in 1905, by States, and the value of coal or wood displaced by same, as reported by 2,139 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	351	$19,237,218	$21,699,582
Ohio	425	10,396,633	12,039,301
West Virginia	76	3,586,608	5,232,861
Indiana	740	3,056,634	3,814,670
New York	148	2,434,894	2,191,405
Kansas	171	2,265,945	3,897,425
Kentucky and Tennessee	44	237,590	239,790
California	19	133,696	246,875
Indian Territory and Oklahoma	42	126,028	228,867
Arkansas and Wyoming	4	21,135	18,900
Colorado	4	20,752	20,752
South Dakota	12	15,200	24,100
Texas and Alabama	8	14,409	18,500
Missouri	25	7,390	7,390
Illinois	66	7,223	7,500
Louisiana	4	1,500	3,000
Total	2,139	41,562,855	49,690,918

USES.

In the following table are specified the uses to which the natural gas produced in the United States in 1905 was put:

Uses to which natural gas produced in the United States in 1905 was put, as reported by 2,139 persons, firms, and corporations.

State.	Companies or individuals reporting.	Domestic consumers supplied.	Establishments supplied.						Gas engines.	Compressors.
			Iron mills.	Steel works.	Glass works.	Brick plants.	Other establishments.	Total.		
Pennsylvania	351	257,416	43	66	109	43	2,584	2,845	443	32
Ohio	425	274,585	14	14	34	39	2,854	2,955	1,294	16
West Virginia	76	45,588	14	4	37	19	1,343	1,417	150	5
Indiana	740	63,191	5	2	52	11	161	231	395	35
New York	148	67,848	......	2	4	......	441	447	88	1
Kansas	171	46,852	5	......	20	33	543	601	276	5
Kentucky and Tennessee	44	13,106	......	1	......	......	5	6	53	3
California	19	4,522	......	......	......	......	10	10	8	2
Indian Territory and Oklahoma	42	3,272	......	1	1	8	29	39	63	......
Arkansas and Wyoming	4	1,602	......	......	......	......	3	3	3	......
Colorado	4	715	......	......	......	......	3	3	3	......
South Dakota	12	316		......	......	......	2	2	7	......
Texas and Alabama	8	229	......	......	......	......	3	3	5	......
Missouri	25	213	......	......	......	......	3	3	3	......
Illinois	66	180	......	......	......	......	3	3	3	......
Louisiana	4	....	......	......	......	......	1	1	....	......
Total	2,139	779,638	81	90	257	153	7,988	8,569	2,794	99

The foregoing table shows a decrease of 208 companies and individuals reported in 1905 as against the year 1904, with an increase in the number of consumers of 67,061 over the number supplied in 1904. There was also an increase of 2,236 in the manufacturing establishments supplied as compared with 1904.

WELL RECORD AND PIPE-LINE REPORT.

In the following table will be found the number of wells drilled and the amount of pipe line which has been laid and operated by the 2,139 firms and corporations operating and handling natural gas in the United States in 1905. This table shows a total of 2,857 wells drilled for gas during the year, of which 556 were dry or nonproductive and 2,301 were productive. During the year 1,337 wells were abandoned, which left a total of 17,144 wells producing gas in the United States at the end of the year 1905.

Pennsylvania stands first in the number of wells drilled, having drilled 933 wells during the year, of which 18 per cent were dry. West Virginia is second, with 413 wells drilled, less than 7 per cent of which were dry. In Indiana there were 326 wells drilled, of which nearly 23 per cent were dry. Both Kansas and Oklahoma and Indian Territory show unfavorable results in the percentage of unproductive wells that were drilled. Kansas drilled 437 wells, of which 31.5 per cent were dry. Oklahoma and Indian Territory drilled 80 wells, of which 36 per cent were dry.

Record of wells and amount of pipe line, as reported by 2,139 persons, firms, and corporations in 1905, by States.

State.	Companies or individuals reporting.	Wells.					Total pipe laid to Dec. 31, 1905.	
		Producing, Dec. 31, 1904.	Producing, drilled in 1905.	Abandoned in 1905.	Producing, Dec. 31, 1905.	Nonproducing holes drilled in 1905.	Feet.	Miles.
Pennsylvania	351	6,352	765	262	6,855	168	63,725,872	12,069.3
Ohio	425	1,661	342	138	1,865	58	34,107,617	6,459.8
West Virginia	76	1,274	385	77	1,582	28	22,389,282	4,240.4
Indiana	740	4,684	252	730	4,206	74	21,707,439	4,111.3
New York	148	754	89	22	821	17	8,112,919	1,536.6
Kansas	171	1,029	340	83	1,286	157	8,860,615	1,678.1
Kentucky and Tennessee	44	147	21	2	166	11	1,109,949	210.2
California	19	45	1	....	46	1	504,655	95.6
Indian Territory and Oklahoma	42	51	51	7	95	29	934,660	177.0
Arkansas and Wyoming	4	8	6	....	14	....	202,480	38.3
Colorado	4	4	....	....	4	....	79,600	15.1
South Dakota	12	10	4	....	14	....	31,850	6.0
Texas and Alabama	8	19	9	1	27	3	143,665	27.2
Missouri	25	40	16	1	55	6	67,475	12.8
Illinois	66	70	8	10	68	2	149,571	28.3
Louisiana	4	2	12	4	10	2	65,560	12.4
Total	2,139	16,150	2,301	1,337	17,114	556	162,193,209	30,718.4

COMBINED VALUE OF NATURAL GAS AND PETROLEUM.

The following tables give the value of natural gas and of petroleum and their combined value in 1904 and 1905, by States, arranged in the order of the value of the combined production:

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	$18,222,242	$36,362,156
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	5,447,622	7,014,930
Indian Territory Oklahoma	49,665		
New York	522,575	1,811,837	2,334,412
Kentucky and Tennessee	322,404	984,938	1,307,342
Louisiana	....	1,073,594	1,073,594
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	101,175,455	139,672,215

Value of the natural gas and petroleum produced in 1905, and their combined value, by States.

State.	Value of natural gas.	Value of crude petroleum.	Value of natural gas and crude petroleum.
Pennsylvania	$19,197,336	$14,653,278	$33,850,614
West Virginia	10,075,804	16,132,631	26,208,435
Ohio	5,721,462	17,054,877	22,776,339
Indiana	3,094,134	9,404,909	12,499,043
Kansas, Indian Territory, and Oklahoma	2,391,973	6,546,398	8,938,371
California	133,696	8,201,846	8,335,542
Texas and Alabama	14,409	7,552,262	7,566,671
New York	623,251	1,557,630	2,180,881
Louisiana	1,500	1,601,325	1,602,825
Kentucky and Tennessee	237,590	943,211	1,180,801
Colorado	20,752	337,606	358,358
Illinois	7,223	116,561	123,784
Arkansas and Wyoming	21,135	51,545	72,680
South Dakota	15,200	....	15,200
Michigan and Missouri	7,390	3,320	10,710
Total	41,562,8[illegible]5	84,157,399	125,720,254

COMPOSITION OF NATURAL GAS AND OF MANUFACTURED GAS.

The following table gives the average composition of natural gas produced in Pennsylvania, northwestern Ohio and Indiana, and Kansas; also the composition of the average gas manufactured from coal, water gas, and producer gas, as determined by analysis. The weight of 1,000 cubic feet, the specific gravity, and the heating value are also given for each.

Analysis of natural and manufactured gases, their weight and heating quality per 1,000 cubic feet, also their specific gravity.

Constituent.	Average Pennsylvania and West Virginia.	Average Ohio and Indiana.	Average Kansas.	Average of coal gas.	Average of water gas.	Average producer gas from bituminous coal.
Marsh gas, CH_4	80.85	93.60	93.65	40.00	2.00	2.05
Other hydrocarbons	14.00	.30	.25	4.00	.00	.04
Nitrogen	4.60	3.60	4.80	2.05	2.00	56.26
Carbonic acid, CO_2	.05	.20	.30	.45	4.00	2.60
Carbonic oxide, CO	.40	.50	1.00	6.00	45.50	27.00
Hydrogen	.10	1.50	.00	46.00	45.00	12.00
Hydrogen sulphide	.00	.15	.00	.00	.00	.00
Oxygen	Trace.	.15	.00	1.50	1.50	.05
Total	100.00	100.00	100.00	100.00	100.00	100.00
Pounds in 1,000 cubic feet [a]	47.50	48.50	49.00	33.00	45.60	75.00
Specific gravity, air being one	0.624	0.637	0.615	0.435	0.600	0.985
B. T. U. per 1,000 cubic feet [b]	1,145,000	1,095,000	1,100,000	755,000	350,000	155,000

[a] 1,000 cubic feet of air at an atmospheric pressure of 14.7 pounds and at a temperature of 62° F. weighs 76.1 pounds, and is a mechanical mixture of 23 parts of oxygen and 77 parts of nitrogen, by weight.
[b] B. T. U.—British thermal units, which indicates the heat necessary to raise one pound of pure water at 39° F. one degree.

PRODUCTION AND USE OF NATURAL GAS BY STATES.

In the following tables are shown the value of the natural gas produced and the value of the natural gas consumed in the year 1905 and the three preceding years in the States of Pennsylvania, West Virginia, Ohio, Indiana, Kansas, and New York. These tables also show in a general way the distribution of this consumption, with a general record of the well condition and the total number of feet of pipe line in use to December 31, 1905. The tables are arranged in the order of the value of the gas produced.

PENNSYLVANIA.

Both the production and the consumption of natural gas in the State of Pennsylvania continue to increase. The gas consumed has increased $2,031,414 in value over the quantity consumed in 1904. The value of the production has increased $1,058,422. This steady increase in the production of natural gas from the State in which it was first and has longest been put to large commercial use is remarkable. The new production comes from the deep sands in Armstrong and Clarion counties and from the southwest corner of the State.

Record of natural-gas industry in Pennsylvania, 1902–1905.

	1902.	1903.	1904.	1905.
Amount received for sale of gas or value of gas consumed	$13,942,783	$16,060,196	$17,205,804	$19,237,218
Value of natural gas produced	$14,352,183	$16,182,834	$18,139,914	$19,197,336
Value of coal and wood displaced	$17,912,629	$20,075,245	$18,237,920	$21,699,582
Domestic consumers supplied	185,678	214,432	238,481	257,416
Iron and steel works supplied	99	96	100	109
Glass works supplied	124	122	89	109
Other establishments supplied	2,225	2,616	2,740	2,627
Total establishments supplied	2,448	2,834	2,929	2,845
Total wells producing, Jan. 1	4,529	5,444	5,915	6,352
Total productive wells drilled	775	699	701	765
Total wells abandoned	203	228	264	262
Total wells producing, Dec. 31	5,101	5,915	6,352	6,855
Total dry holes drilled	232	126	174	168
Total feet of pipe laid to Dec. 31	48,863,621	53,886,301	60,434,996	63,725,872
Number establishments reporting	379	414	414	351

WEST VIRGINIA.

The value of natural gas consumed in West Virginia in 1905 increased only $203,193, while the value of the natural gas produced in that State increased $1,961,655. This increase in production has gone into the States of Pennsylvania and Ohio to supply the increased consumption of natural gas in those two States. The conditions in West Virginia are favorable to a continuous and increasing supply of natural gas for a great many years.

Record of natural-gas industry in West Virginia, 1902–1905.

	1902.	1903.	1904.	1905.
Amount received from sale of gas, or value of gas consumed	$2,473,174	$3,125,061	$3,383,515	$3,586,608
Value of natural gas produced	$5,390,181	$6,882,359	$8,114,249	$10,075,804
Value of other fuel displaced	$2,994,777	$4,375,000	$4,780,907	$5,232,861
Domestic consumers supplied	29,357	36,179	44,563	45,588
Iron and steel works supplied	11	9	9	18
Glass works supplied	31	25	32	37
Other establishments supplied	835	1,088	964	1,362
Total establishments supplied	877	1,122	1,005	1,417
Total wells producing Jan. 1	794	903	1,058	1,274
Total productive wells drilled	142	242	292	385
Total wells abandoned	51	46	76	77
Total wells producing Dec. 31	885	1,099	1,274	1,582
Total dry holes drilled	37	43	33	28
Total feet of pipe laid to Dec. 31	14,548,395	18,224,176	20,787,732	22,389,282
Number establishments reporting	79	88	90	76

OHIO.

The value of the natural gas consumed in Ohio increased $1,002,790 in 1905 over the year 1904; the value of the gas produced in this State increased $405,895.

The production of natural gas in Ohio comes from different horizons in the three different gas districts of the State. In the southeast section the natural gas is produced from the Salt sand and the Berea sandstone; in the central section there is a field of considerable extent which obtains its gas from the Clinton limestone; and in the northwest portion of the State the gas is obtained from the Trenton limestone under conditions similar to those of the gas field in Indiana. The gas field in the northwest portion of the State has been more extensively drawn upon than the other areas and is more nearly exhausted. The Clinton limestone field in the central portion of the State was discovered and developed during the year 1900-1901, since which time it has been gradually extended. The wells of this field run in depth from 2,150 to 2,250 feet. The gas is under a high pressure and the volume from the wells is large. The gas areas of southeastern Ohio from the Salt sand and the Berea sandstone are in small pools of limited area. These small accumulations will probably continue to be found for a good many years to come.

Record of natural-gas industry in Ohio, 1902–1905.

	1902.	1903.	1904.	1905.
Amount received for sale of gas or value of gas consumed	$4,785,766	$7,200,867	$9,393,843	$10,396,633
Value of natural gas produced	$2,355,458	$4,479,040	$5,315,564	$5,721,462
Value of coal and wood displaced	$5,351,878	$8,155,570	$9,938,686	$12,039,301
Domestic consumers supplied	120,127	197,710	232,557	274,585
Iron and steel works supplied	17	19	9	28
Glass works supplied	56	63	15	34
Other establishments supplied	713	1,704	1,112	2,893
Total establishments supplied	786	1,786	1,136	2,955
Total wells producing Jan. 1	1,099	1,343	1,523	1,661
Total productive wells drilled	266	290	334	342
Total wells abandoned	75	110	196	138
Total wells producing Dec. 31	1,290	1,523	1,661	1,865
Total dry holes drilled	40	62	49	58
Total feet of pipe laid to Dec. 31	20,093,670	27,876,583	30,579,825	34,107,617
Number of establishments reporting	451	515	453	425

INDIANA.

The natural-gas industry of Indiana is on the decline. The quantity of natural gas produced within the State has steadily decreased since the year 1902. During 1905 the value of the gas produced was $3,094,134, and the value of the gas consumed was $3,056,634.

The steady and probable permanent decline in the production of the gas fields in Indiana has compelled the removal of some of the heavy fuel-using commercial establishments, and the adoption by others of producer gas. The convenience and perfect adaptability of natural gas as a domestic fuel would indicate that domestic consumers should be given preference in its use over the large commercial industries.

Record of natural-gas industry in Indiana, 1902–1905.

	1902.	1903.	1904.	1905.
Amount received for sale of gas or value of gas consumed	$3,710,080	$5,915,367	$4,282,409	$3,056,634
Value of natural gas produced	$7,081,344	$6,098,364	$4,342,409	$3,094,134
Value of coal and wood displaced	$10,066,248	$8,281,515	$5,318,752	$3,814,670
Domestic consumers supplied	101,481	90,118	84,862	63,194
Iron and steel works supplied	20	23	12	7
Glass works supplied	141	130	81	52
Other establishments supplied	3,121	867	297	172
Total establishments supplied	3,282	1,020	390	231
Total wells producing, Jan. 1	5,371	5,876	5,785	4,684
Total productive wells drilled	1,331	895	706	252
Total wells abandoned	882	1,257	1,807	730
Total wells producing, Dec. 31	5,820	5,514	4,684	4,206
Total dry holes drilled	205	242	153	74
Total feet of pipe laid to Dec. 31	36,121,980	34,838,053	27,760,588	21,707,439
Number establishments reporting	929	924	846	740

KANSAS.

Kansas, Oklahoma, and Indian Territory are the new great gas fields of the United States. During the year 1905 a large consolidation of the companies in Kansas took place. Extensive pipe lines have been laid, which reach to Kansas City and to most of the larger commercial communities. The value of the natural gas produced amounted to $2,261,836, and the value of that consumed was $2,265,945. Both the quantity produced and that consumed will probably greatly increase within the next few years, and some of the product will probably be transported beyond the boundary of the State for consumption. The gas in this field comes from sand rocks within the Cherokee shales at the base of the Coal Measures. This horizon has furnished some very large producing wells. The initial rock pressure was from 550 to 650 pounds to the square inch, and the flow was as high as 37,000,000 cubic feet per day from one well.

Record of natural-gas industry in Kansas, 1902 to 1905.

	1902.	1903.	1904.	1905.
Amount received for sale of gas, or value of gas consumed	$824,431	$1,123,849	$1,517,643	$2,265,945
Value of natural gas produced	$824,431	$1,123,849	$1,517,643	$2,261,836
Value of coal and wood displaced	$1,175,349	$1,676,351	$2,275,875	$3,897,425
Domestic consumers supplied	13,488	15,918	27,204	46,852
Iron and steel works supplied	1	2	10	5
Zinc smelters supplied	9	11	16	16
Glass works supplied	3	3	14	20
Brick works supplied	14	14	17	33
Other establishments supplied	64	113	241	527
Total establishments supplied	91	143	298	601
Total wells producing Jan. 1	299	404	726	1,029
Total productive wells drilled	144	295	378	340
Total wells abandoned	24	33	75	83
Total wells producing Dec. 31	419	666	1,029	1,286
Total dry holes drilled	63	66	135	157
Total feet pipe laid to Dec. 31	5,034,791	5,598,720	7,022,852	8,860,615
Number of establishments reporting	80	120	190	171

NEW YORK.

The State of New York is a greater consumer than a producer of natural gas. The territory from which the gas is produced is almost entirely in the western portion of the State, the larger part of the gas produced coming from the Erie County field and the neighborhood of Wellsville and Ricebrook, in Allegany County. There are a large number of wells along the south shores of Lake Ontario and Lake Erie which produce gas from the shale rock, not in large quantities, but in sufficient volume to furnish domestic fuel for from one to four families. During the year 1905 New York produced natural gas valued at $623,251 and consumed gas valued at $2,434,894. Some of the gas consumed in New York was imported from Canada. This amounted to 984,740 cubic feet, valued at $49,237.

Record of natural-gas industry in New York, 1902–1905.

	1902.	1903.	1904.	1905.
Amount received for sale of gas or value of gas consumed	$1,723,709	$1,944,667	$2,222,980	$2,434,894
Value of natural gas produced	$346,471	$493,686	$522,575	$623,251
Value of coal and wood displaced	$1,771,077	$1,992,726	$2,262,711	$2,191,405
Domestic consumers supplied	50,536	57,935	67,203	67,848
Iron and steel works supplied	1	....	1	2
Glass works supplied	8	5	6	4
Other establishments supplied	206	203	444	441
Total estabishments supplied	215	208	451	447
Total wells producing Jan. 1	583	652	707	754
Total productive wells drilled	69	75	78	89
Total wells abandoned	14	20	31	22
Total wells producing Dec. 31	638	707	754	821
Total dry holes drilled	8	11	12	17
Total feet of pipe laid to Dec. 31	5,894,517	7,413,194	7,899,723	8,112,919
Number of establishments reporting	116	141	153	148

LOUISIANA.

During the year 1905 a new gas area was opened up near Caddo Lake, north of Shreveport, in Louisiana. This district has been remarkable for the extent and the force of the blow-outs which have completely demolished some of the wells. The wells of this district are drilled by the rotary process, and gas is obtained at a depth of about 1,250 feet. Arrangements are being made to deliver and market gas from this field in Shreveport, La.

PRODUCTION OF NATURAL GAS IN CANADA.

The following statistics regarding the production of natural gas in Ontario, Canada, have been furnished by the Ontario Bureau of Mines, Toronto:

Statistics of natural-gas production in the Province of Ontario, Canada, 1893–1905.

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	....	253,524	53,674
1905	273	462½	130	316,476	88,865

It is reported by the geological survey of Canada that during the year 1905 there was produced at Medicine Hat, Province of Alberta, Canada, gas to the value of $33,000 from a total of 12 producing gas wells. This makes the total value of gas produced in Canada in 1905 amount to $349,476.

PETROLEUM.[a]

By W. T. Griswold.

[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 features in connection with the production of petroleum in the United States for the year 1905 are as follows:

(1) The production was greater by 17,636,620 barrels than in any other previous year.

(2) The value of the production for the year 1905 was $17,018,056 less than for the year 1904.

(3) The production of petroleum in the United States has more than doubled within the last six years, the increase being of the heavier grades of the fuel class, while the production of lighter or illuminating oils has remained constant.

(4) During the year the development of the Mid-Continent field and the extension into Illinois of the Lima-Indiana field indicate a great increase in the future production of the lighter grades of oil.

(5) The production of the great Eastern fields shows indications of permanent decrease.

(6) The completion of the pipe line from Humboldt, Kans., to Whiting, Ind., marks another step in the transportation of oil.

PRODUCTION.

During the year 1905 there were produced within the United States 134,717,580 barrels of petroleum. This is an increase over the production of the year 1900 of 71,097,051 barrels, or considerably more than any total yearly production up to 1902. The foregoing statement gives an idea of the magnitude of the increase in the oil business of the United States. It does not, however, give a true and clear understanding of the business at this time. A simple statement of the number of barrels of petroleum taken from the earth each year no longer shows the condition of the business. The kind and quality of the oil produced must now be taken into consideration to have an understanding of the relation of production to demand and consumption.

Production of fuel oil.—Of the production of the year 1905, 70,474,078 barrels are from the Gulf and California fields. This is almost exactly the quantity by which the production of the year 1905 exceeds that of the year 1900. The petroleum of the Gulf and California fields is of the heavier variety and has a residue of asphaltum. Oil of this quality, although capable of producing a small percentage of illuminating oil, has its principal value in its use as a fuel. It is the demand for this purpose which must be looked to for the consumption of the production of heavy oils.

[a] As in preceding reports, the compilation of the statistical tables is chiefly the work of Miss Belle Hill, of this office.—D. T. D.

The growth of this demand is bound to take time; not only must the consumer be persuaded that it is cheaper and more desirable at the present price, but that the future supply will remain sufficient to keep the price below that of other fuels. The changing and arranging of furnaces to make them applicable to the burning of a liquid fuel is a strong influence in retarding the adoption of petroleum for this purpose.

The advantages in the use of petroleum as a fuel are many, and its acceptance as such is sure to grow until the price arrives at a figure that will bring it into competition with other fuels. It is well established that a barrel of petroleum is equivalent in heat-producing effect to between one-fourth and one-third of a ton of coal; hence the value of fuel petroleum must finally adjust itself to the cost of one-fourth to one-third of a ton of coal at the point of consumption.

The present price of petroleum of the Gulf and California type is no determination of its value. For a period of five years the quantity of production has increased each year much faster than the commercial world could adjust itself to the use of this new fuel. That this great increase in production each year can go indefinitely on is improbable, and as the steady increase in the consumption of oil for heat-making purposes is an assured fact, this condition will shortly bring about an adjustment between production and consumption.

Production of illuminating oil.—Prior to the year 1904 the greater part of the lighter grades of petroleum that are especially adaptable to the manufacture of the illuminating oils came from the Appalachian and the Lima-Indiana fields. For a number of years the combined production of the two fields has been remarkably constant. During the time between the years 1894–1903, inclusive, it has averaged about 55,500,000 barrels per year. During the year 1904 the Appalachian field showed a slight falling off in production as compared with 1903, and in 1905 a decrease in production of 6.5 per cent as compared with 1904.

The Lima-Indiana and Illinois field held its production in 1904, but fell off 9.6 per cent in the year 1905 as compared with the preceding year, notwithstanding the adding of the State of Illinois to that field and the addition of 181,084 barrels of production from that source.

During the year 1904 the Mid-Continent field became an important factor in the production of the lighter petroleum. It added 4,250,779 barrels of oil during that year, not all of which, however, could be classed as of the lighter grades of petroleum. In 1905 the production increased to 12,013,495 barrels, with a much larger percentage of the better grades of petroleum. This increase from the new field more than offsets the decrease of the old territory, so that the total production of the lighter grades of oil during 1905 was fully 7,000,000 above the average production for a number of years.

Consumption of illuminating oil.—The consumption of illuminating oil from 1894 to 1903 slightly exceeded the production. The stocks held by the large pipe-line companies, which were 33,772,823 barrels at the end of the year 1897, were reduced to 20,772,823 barrels at the end of the year 1903. During the year 1904 there was a consumption of 55,968,171 barrels against a production of 61,715,278 barrels, and in 1905 a consumption of 60,875,677 barrels against a production of 63,855,710 barrels. These two years caused an increase in the stocks held of 8,717,140 barrels.

It is probable that the current year will show a still greater falling off in the production of the Appalachian field than was experienced in 1905. The production from the State of Illinois will probably fully maintain the production of the Lima-Indiana and Illinois field, while all indications point to a very large production from the Mid-Continent field. Even with the maintenance of the large consumption of the year 1905, there is every indication of a strong increase in the accumulated stocks.

In the following table are given the production and the consumption from the Appalachian, the Lima-Indiana and Illinois, and the Mid-Continent fields, with the stocks held by the large pipe-line companies at the end of each year, and the average price during the year paid per barrel for the Pennsylvania grade of oil for the years 1894–1905, inclusive:

Production, consumption, and stocks of illuminating oil held at end of each year from the Appalachian, the Lima-Indiana and Illinois, and the Mid-Continent fields, 1894–1905.

[Barrels of 42 gallons.]

Year.	Production.	Consumption.	Stocks at end of year.	Average price per barrel of Pennsylvania oil.
1894	48,120,364	52,276,169	26,658,146	$0.83 7/8
1895	51,242,047	51,060,561	26,839,632	1.35 7/8
1896	59,341,763	53,132,903	33,048,492	1.17 7/8
1897	58,117,527	57,393,196	33,772,823	.78 5/8
1898	52,111,088	58,916,416	26,967,495	.91 1/8
1899	53,363,772	56,334,149	23,997,118	1.29 3/8
1900	58,135,569	53,668,211	28,461,476	1.35 1/4
1901	55,740,951	56,810,629	27,395,798	1.21
1902	55,746,462	59,967,942	23,174,318	1.23 3/4
1903	56,709,637	59,171,846	20,712,109	1.59
1904	61,715,278	55,968,171	26,459,216	1.62 3/4
1905	63,855,710	60,895,677	29,429,249	1.39 3/8

PRODUCTION AND VALUE.

In the following table is given a statement of the total production of crude petroleum in the United States during the years 1904 and 1905, also the value of this production, with the average price per barrel of the petroleum from each State:

Total quantity and value of crude petroleum produced in the United States and the average price per barrel in 1904 and 1905, by States.

[Barrels.]

State.	1904.			1905.		
	Production.	Value.	Average price per barrel.	Production.	Value.	Average price per barrel.
California	29,649,434	$8,265,434	$0 279	33,427,473	$8,201,846	$0.245
Colorado	501,763	578,035	1.152	376,238	337,606	.897
Illinois	....	....	....	181,084	116,561	.641
Indiana	11,339,124	12,235,674	1.079	10,964,247	9,404,909	.858
Indian Territory, Oklahoma	1,366,748	5,417,622	.970	12,013,495	6,546,398	.545
Kansas	4,250,779					
Kentucky, Tennessee	998,284	984,938	.9866	1,217,337	943,211	.775
Louisiana	2,958,958	1,073,594	.3628	8,910,416	1,601,325	.180
Michigan, Missouri	2,572	4,769	1.854	3,100	3,320	1.071
New York	1,113,264	1,811,837	1.6275	1,117,582	1,557,630	1.394
Ohio	18,876,631	23,730,515	1.257	16,346,660	17,054,877	1.043
Pennsylvania	11,125,762	18,222,242	1.638	10,437,195	14,653,278	1.404
Texas	22,241,413	8,156,220	.367	28,136,189	7,552,262	.268
West Virginia	12,644,686	20,583,781	1.628	11,578,110	16,132,631	1.393
Wyoming	11,542	80,794	7.00	8,454	51,545	6.10
Total	117,080,960	101,175,455	.864	134,717,580	84,157,399	.625

The increase or decrease in the production by States, as well as the percentage of increase or decrease in 1905 compared with 1904, are shown in the following table:

Total production of crude petroleum and percentage of increase or decreases, by States, in 1905, as compared with 1904.

[Barrels.]

State.	Production.		Increase.	Decrease.	Percentage.	
	1904.	1905.			Increase.	Decrease.
California	29,649,434	33,427,473	3,778,039		12.74	
Colorado	501,763	376,238		125,525		25.02
Illinois		181,084	181,084			
Indiana	11,339,124	10,964,247		374,877		3.31
Indian Territory, Oklahoma	1,366,748	12,013,495 (Indian Territory, Oklahoma, Kansas)	6,395,968		113.86	
Kansas	4,250,779					
Kentucky, Tennessee	998,284	1,217,337	219,053		21.94	
Louisiana	2,958,958	8,910,416	5,951,458		201.13	
Michigan, Missouri	2,572	3,100	528		20.53	
New York	1,113,264	1,117,582	4,318		.39	
Ohio	18,876,631	16,346,660		2,529,971		13.40
Pennsylvania	11,125,762	10,437,195		688,567		6.19
Texas	22,241,413	28,136,189	5,894,776		26.50	
West Virginia	12,644,686	11,578,110		1,066,576		8.435
Wyoming	11,542	8,454		3,088		26.75
Total	117,080,960	134,717,580	17,636,620		15.06	

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 1904 and 1905:

Rank of petroleum-producing States and Territories, with quantity produced and percentage of each, in 1904 and 1905.

[Barrels.]

State.	1904. Rank.	Quantity.	Percentage.
California	1	29,649,434	25.33
Texas	2	22,241,413	19.00
Ohio	3	18,876,631	16.13
West Virginia	4	12,644,686	10.80
Indiana	5	11,339,124	9.69
Pennsylvania	6	11,125,762	9.50
Kansas	7	4,250,779	3.63
Louisiana	8	2,958,958	2.51
Indian Territory, Oklahoma	9	1,366,748	1.17
New York	10	1,113,264	.95
Kentucky, Tennessee	11	998,284	.85
Colorado	12	501,763	.43
Wyoming	13	11,542	.01 (Wyoming, Michigan, Missouri)
Michigan, Missouri	14	2,572	
Total		117,080,960	100.00

State.	1905. Rank.	Quantity.	Percentage.
California	1	33,427,473	24.81
Texas	2	28,136,189	20.89
Ohio	3	16,346,660	12.13
Kansas, Indian Territory, Oklahoma	4	12,013,495	8.92
West Virginia	5	11,578,110	8.59
Indiana	6	10,964,247	8.14
Pennsylvania	7	10,437,195	7.75
Louisiana	8	8,910,416	6.61
Kentucky, Tennessee	9	1,217,337	.90
New York	10	1,117,582	.83
Colorado	11	376,238	.28
Illinois	12	181,084	.13
Wyoming	13	8,454	.009 (Wyoming, Michigan, Missouri)
Michigan, Missouri	14	3,100	
Total		134,717,580	100.00

Rank of petroleum-producing States and Territories, with value of production and percentage of each, in 1904 and 1905.

State.	1904. Rank.	1904. Value.	1904. Percentage.	State.	1905. Rank.	1905. Value.	1905. Percentage.
Ohio	1	$23,730,515	23.46	Ohio	1	$17,054,877	20.27
West Virginia	2	20,583,781	20.35	West Virginia	2	16,132,631	19.17
Pennsylvania	3	18,222,242	18.01	Pennsylvania	3	14,653,278	17.41
Indiana	4	12,235,674	12.09	Indiana	4	9,404,909	11.18
California	5	8,265,434	8.17	California	5	8,201,846	9.74
Texas	6	8,156,220	8.06	Texas	6	7,552,262	8.97
Kansas, Indian Territory, Oklahoma	7	5,447,622	5.39	Kansas, Indian Territory, Oklahoma	7	6,546,398	7.78
New York	8	1,811,837	1.79	Louisiana	8	1,601,325	1.90
Louisiana	9	1,073,594	1.06	New York	9	1,557,630	1.85
Kentucky, Tennessee	10	984,938	.97	Kentucky, Tennessee	10	943,211	1.12
Colorado	11	578,035	.57	Colorado	11	337,606	.40
Wyoming	12	80,794	.08 (Wyoming, Michigan, Missouri)	Illinois	12	116,561	.14
Michigan, Missouri	13	4,769		Wyoming, Michigan, Missouri	13	54,865	.07
Total	......	101,175,455	100.00	Total	......	84,157,399	100.00

California still maintains a position at the head of the producing States. Its output during the year 1905 was over one-fourth of the total production of the United States. Texas followed second, showing a production of one-fifth of the total production of the United States. The production from Kansas, Indian Territory, and Oklahoma has not been divided into the quantity from each separate State. This places the combination of the three States in fourth place, ahead of West Virginia and Indiana, a position which, when divided into separate States, they can not maintain. Illinois comes in as a producing State for the first time, holding twelfth place.

When the States are arranged in the order of value of production, the positions are materially changed. Ohio stands first, with a value equal to one-fifth of the total value of the petroleum produced, with West Virginia second and Pennsylvania third, while California drops to fifth place, with a value of less than 10 per cent of the total.

PRODUCTION OF CRUDE PETROLEUM IN THE UNITED STATES FROM 1859 TO 1905, INCLUSIVE.

In the following table will be found a statement of the production of crude petroleum from each State of the United States from the year 1859 to and including the production of the year 1905.

In the previous publications of this table an estimated number of barrels has been included in the production from a number of States for the time prior to the date of collecting accurate statistics. These quantities have been omitted from the table as now published.

Production of crude petroleum in the United States, 1859–1905 by years and by States.

[Barrels of 42 gallons.]

Year.	Pennsylvania and New York.	Ohio.	West Virginia.	California.	Kentucky and Tennessee.	Colorado.	Indiana.	Illinois.
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							
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				
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	1,460
1890	28,458,208	16,124,656	492,578	307,360	6,000	368,842	63,496	900
1891	33,009,236	17,740,301	2,406,218	323,600	9,000	665,482	136,634	675
1892	28,422,377	16,362,921	3,810,086	385,049	6,500	824,000	698,068	521
1893	20,314,513	16,249,769	8,445,412	470,179	3,000	594,390	2,335,293	400
1894	19,019,990	16,792,154	8,577,624	705,969	1,500	515,746	3,688,666	300
1895	19,144,390	19,545,233	8,120,125	1,208,482	1,500	438,232	4,386,132	200
1896	20,584,421	23,941,169	10,019,770	1,252,777	1,680	361,450	4,680,732	250
1897	19,262,066	21,560,515	13,090,045	1,903,411	322	384,934	4,122,356	500
1898	15,948,464	18,738,708	13,615,101	2,257,207	5,568	444,383	3,730,907	360
1899	14,374,512	21,142,108	13,910,630	2,642,095	18,280	390,278	3,848,182	360
1900	14,559,127	22,362,730	16,195,675	4,324,484	62,259	317,385	4,874,392	200
1901	13,831,996	21,648,083	14,177,126	8,786,330	137,259	460,520	5,757,086	250
1902	13,183,610	21,014,231	13,513,345	13,984,268	185,331	396,901	7,480,896	200
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	
1905	11,554,777	16,346,660	11,578,110	33,427,473	1,217,337	376,238	10,964,247	181,084
Total.	664,713,393	339,254,894	165,823,487	129,118,852	3,242,186	8,214,852	77,325,997	187,660

Production of crude petroleum in the United States, 1859–1905, by years and by States—Con.

[Barrels of 42 gallons.]

Year.	Kansas.	Texas.	Missouri.	Indian Territory.	Wyoming.	Louisiana.	United States.	Total value.
1859							2,000	$32,000
1860							500,000	4,800,000
1861							2,113,609	1,035,668
1862							3,056,690	3,209,525
1863							2,611,309	8,225,663
1864							2,116,109	20,896,576
1865							2,497,700	16,459,853
1866							3,597,700	13,455,398
1867							3,347,300	8,066,993
1868							3,646,117	13,217,174
1869							4,215,000	23,730,450
1870							5,260,745	20,503,754
1871							5,205,234	22,591,180
1872							6,293,194	21,440,503
1873							9,893,786	18,100,464
1874							10,926,945	12,647,527
1875							8,787,514	7,368,133
1876							9,132,669	22,982,822
1877							13,350,363	31,788,566
1878							15,396,868	18,044,520
1879							19,914,146	17,210,708
1880							26,286,123	24,600,638
1881							27,661,238	23,512,051
1882							30,349,897	23,631,165
1883							23,449,633	25,740,252
1884							24,218,438	20,476,924
1885							21,858,785	19,193,694
1886							28,064,841	20,028,457
1887							28,283,483	18,856,606
1888							27,612,025	17,950,353
1889	500	48	20				35,163,513	26,963,340
1890	1,200	54	278				45,823,572	35,365,105
1891	1,400	54	25	30			54,292,655	30,526,553
1892	5,000	45	10	80			50,514,657	25,906,463
1893	18,000	50	50	10			48,431,066	28,932,326
1894	40,000	60	8	130	2,369		49,344,516	35,522,095
1895	44,430	50	10	37	3,455		52,892,276	57,691,279
1896	113,571	1,450	43	170	2,878		60,960,361	58,518,709
1897	81,098	65,975	19	625	3,650		60,475,516	40,929,611
1898	71,980	546,070	10		5,475		55,364,233	44,193,359
1899	69,700	669,013	132		5,560		57,070,850	64,603,904
1900	74,714	836,039	[a] 1,602	6,472	5,450		63,620,529	75,752,691
1901	179,151	4,393,658	[b] 2,335	10,000	5,400		69,389,194	66,417,335
1902	331,749	18,083,658	[a] 757	[c] 37,100	6,253	548,617	88,766,916	71,178,910
1903	932,214	17,955,572	[a] 3,000	[c] 138,911	8,960	917,771	100,461,337	94,694,050
1904	4,250,779	22,241,413	[a] 2,572	[c] 1,366,748	11,542	2,958,958	117,080,960	101,175,455
1905	[d] 12,013,495	28,136,189	[a] 3,100	([e])	8,454	8,910,416	134,717,580	84,157,399
Total.	18,228,981	92,929,398	13,971	1,560,313	69,446	13,335,762	1,514,019,192	1,442,326,201

[a] Includes the production of Michigan.
[b] Includes production of Michigan and small production in Oklahoma
[c] Includes production of Oklahoma.
[d] Includes production of Indian Territory and Oklahoma.
[e] Included with Kansas.

OIL FIELDS OF THE UNITED STATES.

The oil production of the United States comes from five great fields and a few scattering States. The division into fields is governed by the quality of oil produced and the geographical location. This division allows a comparison of the condition in 1905 with previous years to be made separately for the areas from which the production finds different uses in the commercial world, and by considering each of the great fields as a unit the rate of increase or decrease in production of an oil of particular qualities can be followed from year to year. Most of the great fields include more than one State, and in one case a State enters into two fields; this is Ohio, which in its eastern and southern portion belongs to the Appalachian field and in its western part to the Lima-Indiana and Illinois field.

The Appalachian field.—This field is the pioneer oil producer of the United States. From its point of discovery on Oil Creek, in western Pennsylvania, it has been extended in a general northeastern and southwestern direction until it now takes in an area of fully 50,000 square miles and includes the production from New York, Pennsylvania, eastern and southern Ohio, West Virginia, Tennessee, and Kentucky.

Lima-Indiana and Illinois field.—In November, 1885, oil in commercial quantities was produced near Findlay, in northwestern Ohio. This territory has been expanded until now it extends diagonally across the northwest corner of Ohio and into Indiana. During the year 1905 a production of considerable extent was developed in eastern Illinois near the Indiana line. These different productions are all grouped into the Lima-Indiana and Illinois field, which includes the production from western Ohio, Indiana, and Illinois.

Mid-Continent field.—The year 1894 is the date of the first successful production of natural gas in commercial quantities in Kansas, and although a small quantity of oil was found at or near this date, it was not until the year 1899 that this oil field was thoroughly opened up by Mr. I. N. Knapp near Chanute, Kans. Since that time prospecting has gone on rapidly, extending the development in a southwest direction into Oklahoma and Indian Territory. The Mid-Continent field includes the oil territory in Missouri, Kansas, Oklahoma, and Indian Territory.

Gulf field.—The production from Texas and Louisiana is included in the Gulf field. The prominence of this field commenced with the Lucas gusher at Spindle Top on January 10, 1901. Prior to this time there was from Corsicana and other districts of Texas a production of oil of entirely different qualities from that produced below the coastal plain of Texas and Louisiana. This difference in quality would justify the separation of the Corsicana district into a distinct field, but as the oil from this district is only about 1 per cent of the production of the Gulf field, the separation has not been made in this report.

California field.—Petroleum has been known and used in a small way in California since 1856. In 1865 an oil excitement passed over the State, during which many wells were drilled and some petroleum was found. The real opening up of California as a great petroleum field dates, however, from 1892, when Mr. E. S. Doheny drilled a shallow well near an asphaltum deposit in the city of Los Angeles and obtained a small but steady production of petroleum.

Other States.—Small quantities of oil have been produced for a number of years from Wyoming, Colorado, and Michigan. There are indications of oil, but no actual production from a number of other States. Wyoming shows the greatest probability of developing an oil field of large importance.

In the following table is given the total production of the different fields by years from 1900 to 1905, inclusive:

PRODUCTION BY FIELDS.

The production of petroleum in the principal fields of the United States from 1900 to 1905, inclusive, was as follows:

Production of petroleum in the United States, 1900–1905, by fields.

[Barrels of 42 gallons.]

Field.	1900.	1901.	1902.	1903.	1904.	1905.
Appalachian	36,295,433	33,618,171	32,018,787	31,558,248	31,408,567	29,366,960
Lima-Indiana and Illinois	21,758,950	21,933,629	23,358,826	24,080,264	24,689,184	22,475,255
Mid-Continent	81,186	189,151	368,849	1,071,125	5,617,527	12,013,495
Gulf	836,039	4,393,658	18,632,275	18,873,343	25,200,371	37,046,605
California	4,324,484	8,786,330	13,984,268	24,382,472	29,649,434	33,427,473
Other	324,437	468,255	403,911	495,885	515,877	387,792
Total	63,620,529	69,389,194	88,766,916	100,461,337	117,080,960	134,717,580

Percentages of total crude petroleum produced in the several fields, 1900–1905.

	1900.	1901.	1902.	1903.	1904.	1905.
Appalachian	57.05	48.45	36.07	31.41	26.83	21.80
Lima-Indiana and Illinois	34.20	31.61	26.31	23.97	21.08	16.68
Mid-Continent	.13	.27	.42	1.07	4.80	8.92
Gulf	1.31	6.33	20.99	18.79	21.52	27.50
California	6.80	12.66	15.75	24.27	25.33	24.81
Other	.51	.68	.46	.49	.44	.29
Total	100.00	100.00	100.00	100.00	100.00	100.00

THE APPALACHIAN OIL FIELD.

Geology.—The great Appalachian oil field, which extends from Wellsville, N. Y., along the western slope of the Allegheny Mountains to the north boundary of Tennessee, produces its oil and gas from porous sandstones and conglomerates which are embedded in and underlain by great masses of shale. These sandstone beds are each of large extent, underlying many counties and in some cases extending into a number of States. They occupy a position in the geological column of over 2,000 feet, extending from the Allegheny formation of the Pennsylvania period to the base of the Devonian period.

In general the full field occupies the bottom and western side of a large spoon-shaped trough. In detail the slope of the formation is not regular, but is a combination of two sets of foldings. The main one has a northeast and southwest strike, generally parallel to the ridges of the Appalachian Mountains. This is crossed by secondary folding of less pronounced character at nearly right angles to the first. This combination forms a system of structural condition which consists of canoe-shaped basins and elongated domes. The structural condition of the rock is the important factor in the accumulation of the oil and gas, the exact location of which is governed by the quantity of saline water contained within a particular sandstone. The younger or higher sands in the geological column are found to be completely saturated by salt water over a greater extent than the older or lower sandstones. This causes the oil accumulations to be higher up on the anticlines in the younger rocks, and mostly within the synclines in the older or lower sandstone beds.

Oils of the Appalachian field.—Almost the entire product of the Appalachian field is sold under the head of Pennsylvania oil. There are certain districts, such as Tiona and Middle districts, where the quality demands a premium of 10 to 15 cents above the regular Pennsylvania grade. Certain limited areas of Ohio and West Virginia produce oils not fully up to the regular Pennsylvania standard. None of the oil of Kentucky and Tennessee brings as high a price as Pennsylvania oil and some of the oil only about 30 per cent of the price.

In certain districts, such as Franklin in Pennsylvania, Petroleum in West Virginia, and Mecca and Belden in Ohio, a natural lubricating oil is produced. This oil brings a high price, but the quantity is very small when compared with the total production of the Appalachian field.

Transportation.—The oil of the Appalachian field is collected and transported almost entirely by pipe line. A number of great pipe-line systems cover the entire area, reaching each separate tank of the producers. The oil is measured at the tanks and is turned into the line, from which it is delivered at the refineries or at seaboard, less 2 per cent for evaporation and loss.

PRODUCTION OF THE APPALACHIAN FIELD.

In the following table is shown the production for the Appalachian field, by States, in the years 1904 and 1905, with the increase and decrease for each State and the percentage of increase or decrease as compared with the previous year.

This table shows that New York held its own, but that Pennsylvania, West Virginia, and southeastern Ohio fell back from 6 to 9 per cent, while Kentucky and Tennessee, though only making an increased production of 219,053 barrels, made a gain of nearly 22 per cent on their previous record.

Production of petroleum in the Appalachian field in 1904 and 1905, by States, showing increase or decrease.

[Barrels.]

State.	Production.		Increase.	Decrease.	Percentage.	
	1904.	1905.			Increase.	Decrease.
New York	1,113,264	1,117,582	4,318		0.39	
Pennsylvania	11,125,762	10,437,195		688,567		6.18
West Virginia	12,644,686	11,578,110		1,066,576		8.44
Southeastern Ohio	5,526,571	5,016,736		509,835		9.23
Kentucky and Tennessee	998,284	1,217,337	219,053		21.94	
Total	31,408,567	29,366,960		2,041,607		6.50

In the following table is given the total production of the Appalachian field from the year 1859 to 1905, inclusive. In the second column is given the percentage that this production is of the full production of the United States; the increase or decrease in barrels each year is given in the third column; and the average yearly price per barrel in the fourth.

Production of petroleum in the Appalachian field, 1859–1905.

[Barrels.]

Year.	Production.	Per cent of total production.	Increase (+) or decrease (−) from previous year.	Yearly average price per barrel.	Year.	Production.	Per cent of total production.	Increase (+) or decrease (−) from previous year.	Yearly average price per barrel.
1859	2,000	100	....	....	1883	23,306,776	99.39	−6,914,485	$1.05¾
1860	500,000	100	+ 498,000	$9.59	1884	23,956,438	98.92	+ 649,662	.83½
1861	2,113,609	100	+1,613,609	.49	1885	21,533,785	98.51	−2,422,653	.87⅞
1862	3,056,690	100	+ 943,081	1.05	1886	26,549,827	94.60	+5,016,042	.71¼
1863	2,611,309	100	+ 445,381	3.15	1887	22,878,241	80.90	−3,671,586	.66¾
1864	2,116,109	100	− 495,200	8.06	1888	16,941,397	61.36	−5,936,844	.87⅝
1865	2,497,700	100	+ 381,591	6.59	1889	22,355,225	63.57	+5,413,828	.94⅛
1866	3,597,700	100	+1,100,000	3.74	1890	30,073,307	65.63	+7,718,082	.86¾
1867	3,347,300	100	− 250,400	2.41	1891	35,848,777	66.03	+5,775,470	.67
1868	3,646,117	100	+ 298,817	3.62½	1892	33,432,377	66.19	−2,416,400	.55⅝
1869	4,215,000	100	+ 568,883	5.63¾	1893	31,365,890	64.76	−2,066,487	.64
1870	5,260,745	100	+1,045,745	3.86	1894	30,783,424	62.38	− 582,466	.83⅞
1871	5,205,234	100	− 55,511	4.34	1895	30,960,639	58.54	+ 177,215	1.35⅞
1872	6,293,194	100	+1,087,960	3.64	1896	33,971,902	55.73	+3,010,263	1.17⅞
1873	9,893,786	100	+3,600,592	1.83	1897	35,230,271	58.25	+1,258,369	.78⅝
1874	10,926,945	100	+1,033,159	1.17	1898	31,717,425	57.29	−3,512,846	.91⅛
1875	8,787,514	100	−2,139,431	1.35	1899	33,068,356	57.94	+1,350,931	1.29⅜
1876	9,120,669	99.87	+ 333,155	2.56¼	1900	36,295,433	57.05	+3,227,077	1.35¼
1877	13,337,363	99.90	+4,216,694	2.42	1901	33,618,171	48.45	−2,677,262	1.21
1878	15,381,641	99.90	+2,044,278	1.19	1902	32,018,787	36.07	−1,599,384	1.23¾
1879	19,894,288	99.90	+4,512,647	.85⅞	1903	31,558,248	31.41	− 460,539	1.59
1880	26,245,571	99.85	+6,351,283	.94½	1904	31,408,567	26.83	− 149,681	1.62¾
1881	27,561,376	99.64	+1,315,805	.85⅞	1905	29,366,960	21.80	−2,041,607	1.39⅜
1882	30,221,261	99.58	+2,659,885	.78⅛					

An inspection of the foregoing table is interesting. It shows that the Appalachian field furnished 100 per cent of the full production of the United States up to the year 1876. From that time forward a growing production in different parts of the United States reduced this percentage slowly until the year 1885. The discovery at that time of the Lima-Indiana and Illinois field rapidly reduced the percentage coming from the Appalachian field. It maintained, however, over 50 per cent of the total production of the United States until the year 1901, when the new production from Texas and California began. Its percentage has since rapidly fallen, owing not so much to its own decrease in production as to the great increase of the new fields. Of the total production of 1905, only 21.80 per cent is credited to the Appalachian field.

In the following table is given the production of the Appalachian field, by States, from 1900 to 1905, inclusive:

Production of petroleum in the Appalachian field, 1900–1905, by States.

[Barrels of 42 gallons.]

Year.	Pennsylvania and New York.	West Virginia.	Southeastern Ohio.	Kentucky and Tennessee.	Total.
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
1905	11,554,777	11,578,110	5,016,736	1,217,337	29,366,960

In the two following tables are given the production of crude petroleum in the Appalachian oil field from 1900 to 1905, the first by months and the second by days. These tables are valuable in so much as they show what months of each year made the highest average production, and also for the comparison of the average daily records of previous years with the production as reported by the press each day.

Production of crude petroleum in the Appalachian oil field, 1900–1905, by months and years.

[Barrels of 42 gallons.]

Month.	1900.	1901.	1902.	1903.	1904.	1905.
January	2,918,175	3,003,285	2,614,845	2,726,634	2,377,630	2,368,186
February	2,595,900	2,567,288	2,253,491	2,353,281	2,294,922	2,207,659
March	3,004,813	2,916,677	2,629,104	2,759,807	2,719,887	2,685,538
April	2,950,469	2,862,813	2,664,668	2,691,431	2,599,224	2,445,161
May	3,148,944	2,963,001	2,759,717	2,681,586	2,743,881	2,685,829
June	3,068,693	2,751,409	2,598,349	2,731,722	2,700,030	2,570,383
July	3,100,319	2,921,520	2,825,398	2,758,308	2,697,037	2,434,710
August	3,198,715	2,941,578	2,728,825	2,628,708	2,822,017	2,523,737
September	3,002,998	2,644,103	2,769,060	2,633,513	2,668,124	2,358,897
October	3,245,506	2,814,972	2,860,506	2,664,422	2,606,321	2,376,013
November	3,009,503	2,590,781	2,609,453	2,374,373	2,558,764	2,268,847
December	3,051,398	2,640,744	2,705,371	2,554,463	2,620,730	2,442,000
Total	36,295,433	33,618,171	32,018,787	31,558,248	31,408,567	29,366,960

In the following table is given the average daily production in the Appalachian oil field from 1900 to 1905, by months and years:

Average daily production of crude petroleum in the Appalachian oil field each month, 1900–1905, by months and years.

[Barrels of 42 gallons.]

Month.	1900.	1901.	1902.	1903.	1904.	1905.
January	94,135	96,880	84,350	87,956	76,698	76,393
February	92,711	91,689	80,482	84,046	79,135	78,845
March	96,929	94,086	84,810	89,026	87 738	86,630
April	98,349	95,427	88,822	89,714	86,641	81,505
May	101,579	95,581	89,023	86,503	88,512	86,640
June	102,290	91,714	86,612	91,057	90,001	85,679
July	100,010	94,243	91,142	88,978	87,001	78,539
August	103,184	94,890	88,027	84,797	91,033	81,411
September	100,100	88,137	92,302	87,784	88,937	78,630
October	104,694	90,806	92,274	85,949	84,075	76,646
November	100,317	86,359	86,982	79,146	85,292	75,628
December	98,432	85,185	87,270	82,402	84,540	78,774
Average	99,440	92,105	87,723	86,461	85,816	80,457

PIPE-LINE REPORTS.

In the following table will be found the statistics of the principal companies engaged in the transportation of petroleum in the Appalachian field. A vast network of lines, amounting to many thousands of miles and extending from New York to Tennessee, connects the receiving tanks with every well of any importance within this great area and within a reasonable distance of the system. In many cases this method of transportation reaches localities in rough, wild sections, which could only be reached at great expense by the ordinary methods of transportation.

These smaller lines, or veins, as it were, reach out and connect with the receiving stations on main lines. The stations are usually located on low ground, compared to the surrounding producing area. A large percentage of oil usually finds its way to the stations by means of gravity and suction pumps; in many cases it is forced by a pump of a greater or less capacity, operated by the economical natural-gas engine.

From the large receiving tanks the petroleum is drawn into the large pumps and forced into the main lines at a pressure often of between 600 and 800 pounds. These massive pumps generally represent the highest known mechanical efficiency in their operation, having triple-expansion engines, Corliss valves, condensers, air pumps, and efficient boilers. They usually develop 300 to 350 horsepower, and pump from 30,000 to 35,000 barrels in twenty-four hours.

These main pumping plants are placed from 30 to 50 miles apart, according to elevation of summits that must be overcome, and by the addition of a parallel line or loop for a portion of the distance these distances between stations can be increased so as to reach localities convenient for fuel or water.

Three tables are given: The first shows the regular runs from the principal pipe lines of the Appalachian oil field by months during the year 1905. The second table gives the regular shipments or deliveries from the same lines by months during the same time. In the third table are given the stocks held at the end of each month during the year 1905 by the same pipe lines; also by the Southern, the Crescent, and the New York pipe lines, which, although receiving no runs directly from the wells, receive irregular deliveries from other pipe lines and carry stocks.

In the following table are shown the total runs and the total shipments, with the stocks held at the end of each year from 1900 to 1905, inclusive, for the Appalachian field:

Pipe-line runs, shipments, and stocks in Appalachian field, 1900–1905.

[Barrels.]

Year.	Total runs.	Total shipments.	Stocks at close of year.
1900	35,540,964	35,401,113	13,475,548
1901	33,091,120	36,481,726	9,635,492
1902	31,404,187	35,192,689	5,741,624
1903	30,693,947	31,636,996	4,854,715
1904	30,358,671	29,067,619	6,395,599
1905	28,080,834	31,063,373	3,542,014

Pipe-line runs in the Appalachian oil field in 1905, by lines and months.

[Barrels of 42 gallons.]

Month.	National Transit.	Southwest.	Eureka.	Tidewater.	Producers and Refiners.	Emery.
January	391,741	198,874	892,301	135,549	156,978	24,410
February	354,363	190,268	885,266	120,572	143,227	19,714
March	446,753	237,359	1,041,691	155,326	171,313	25,688
April	419,022	203,348	924,567	148,188	154,743	24,701
May	467,455	226,156	1,028,263	152,597	164,917	24,804
June	442,315	209,157	978,641	147,015	160,426	25,113
July	410,032	194,059	910,042	140,916	163,683	25,236
August	429,221	203,669	956,722	149,650	164,326	24,435
September	403,798	191,982	872,964	143,312	173,745	24,902
October	408,835	191,613	866,478	143,311	186,475	24,110
November	393,150	189,183	827,467	137,334	188,767	23,924
December	422,076	192,656	890,357	147,919	212,182	26,679
Total	4,988,761	2,428,324	11,074,759	1,721,689	2,040,782	293,716

Month.	United States.	Cumberland.	Franklin.	Buckeye-Macksburg.	Total.	Average daily runs.
January	4,732	77,013	1,517	373,735	2,256,850	72,802
February	2,724	70,955	1,537	335,779	2,124,405	75,872
March	4,895	102,759	5,152	394,614	2,585,550	83,405
April	1,138	100,108	3,296	353,472	2,332,583	77,753
May	9,190	114,146	3,504	383,215	2,574,247	83,040
June	....	117,781	3,298	374,851	2,458,597	81,953
July	4,711	116,740	2,784	346,658	2,314,861	74,674
August	4,308	108,850	3,637	365,282	2,410,100	77,745
September	9,225	105,913	2,940	329,772	2,258,553	75,285
October	1,044	101,159	3,568	338,836	2,265,429	73,078
November	3,492	93,105	2,768	313,046	2,172,236	72,408
December	4,569	102,292	2,946	325,747	2,327,423	75,078
Total	50,028	1,210,821	36,947	4,235,007	28,080,834	76,934

Pipe-line shipments in the Appalachian oil field in 1905, by lines and months.

[Barrels of 42 gallons.]

	National Transit.	Southwest.	Eureka.	Tidewater.	Producers and Refiners'.	Emery.	United States.
January	824,630	43,658	37,984	237,438	176,068	27,453	49,498
February	739,174	45,231	30,185	255,617	164,524	18,319	53,811
March	915,600	45,596	40,062	264,700	164,556	24,579	55,079
April	901,449	58,785	33,596	195,397	189,935	25,701	43,106
May	910,490	60,928	39,700	265,610	177,223	25,433	42,334
June	951,642	58,800	35,145	269,093	182,065	23,885	40,706
July	915,150	65,253	31,307	170,322	198,607	24,452	37,424
August	910,925	66,174	51,880	203,527	197,292	21,570	58,896
September	776,302	66,118	52,041	210,013	165,980	17,653	(a)
October	855,945	66,187	63,751	206,411	183,222	19,651	(a)
November	998,643	63,524	52,504	232,339	151,997	33,589	(a)
December	1,013,919	67,285	68,232	245,083	179,877	25,959	(a)
Total	10,713,869	707,539	536,387	2,755,550	2,131,346	288,244	380,854

a The United States Pipe Line Company receives crude oil from Emery Pipe Line and Producers and Refiners' Oil Company, so that its deliveries are practically duplicated in reports of the other two lines.

Pipe-line shipments in the Appalachian oil field in 1905, by lines and months—Continued.

	Cumberland.	Southern.	Crescent.	New York.	Franklin.	Buckeye-Macksburg.	Total.
January	16,228	727,633	148,188	181,406	10,821	4,844	2,485,849
February	15,565	606,478	105,774	147,296	5,191	6,481	2,193,646
March	12,551	779,601	198,307	156,629	486	5,904	2,663,650
April	8,179	773,807	216,416	108,573	680	7,002	2,562,626
May	10,765	768,857	168,941	299,064	834	6,074	2,776,253
June	8,547	682,801	183,469	225,215	1,593	6,592	2,669,553
July	9,884	752,120	161,565	77,452	268	8,510	2,452,314
August	12,440	884,616	202,868	365,288	6	7,871	2,983,353
September	16,139	835,084	153,317	178,927	....	6,372	2,477,946
October	18,151	811,454	219,182	251,623	7,185	8,582	2,711,344
November	21,981	753,660	216,265	84,395	8,618	7,105	2,624,620
December	13,834	557,187	169,122	101,977	12,045	7,699	2,462,219
Total	164,264	8,933,298	2,143,414	2,177,845	47,727	83,036	31,063,373

Net stocks held by the principal pipe lines at the close of each month in 1905.

[Barrels of 42 gallons.]

Month.	National Transit.	Southwest.	Eureka.	Tidewater.	Producers and Refiners'.	Emery.	United States.
January	2,347,970	623,119	1,200,820	342,788	308,498	8,905	79,889
February	2,297,577	608,952	1,243,235	312,903	287,202	10,300	86,618
March	2,227,155	693,847	1,234,597	319,116	293,960	11,409	55,154
April	2,111,144	629,407	1,181,458	294,054	258,767	10,409	65,432
May	1,961,781	730,349	1,078,605	314,065	246,461	9,779	66,158
June	1,753,504	762,952	1,037,910	279,200	224,822	11,007	64,680
July	1,782,240	747,786	899,584	287,176	189,899	11,792	82,478
August	1,389,228	704,651	732,523	314,754	156,932	14,657	83,998
September	1,189,809	515,012	961,053	308,598	164,697	21,906	75,353
October	844,160	384,476	906,528	330,096	167,951	26,365	55,569
November	694,525	390,038	737,124	364,738	204,721	16,700	63,869
December	613,805	269,348	887,079	366,284	237,026	17,420	76,351

Month.	Cumberland.	Southern.	Crescent.	New York.	Franklin.	Buckeye-Macksburg.	Total.
January	254,989	474,149	122,480	43,240	33,488	354,445	6,194,780
February	209,911	525,541	147,318	44,671	27,244	360,217	6,161,689
March	191,407	527,595	122,532	51,636	35,664	343,314	6,107,386
April	189,498	474,426	93,632	114,187	38,935	352,107	5,813,456
May	189,160	504,734	113,578	39,830	42,280	316,133	5,612,913
June	207,114	579,185	104,084	6,627	44,657	309,385	5,385,127
July	186,426	597,530	134,068	7,625	47,757	295,619	5,269,980
August	182,692	602,740	125,354	98,434	52,391	297,568	4,735,922
September	147,021	582,828	154,708	16,500	55,631	304,891	4,498,007
October	178,258	578,970	110,492	25,218	52,518	378,599	4,039,200
November	205,267	501,834	72,186	19,569	47,214	379,354	3,697,139
December	216,609	389,013	65,405	13,879	38.616	351,179	3,542,014

In the following table are given the pipe-line runs in the Appalachian oil field from 1900 to 1905, inclusive:

Pipe-line runs in the Appalachian oil field, 1900–1905.

[Barrels of 42 gallons.]

Year.	National Transit.	Tidewater.	Southwest.	Franklin.	Eureka.	Elk.	Emery.
1900	6,899,801	1,645,225	3,716,139	51,405	16,114,588	192,551	313,454
1901	6,207,595	1,445,530	4,018,862	48,107	14,143,726	176,280	344,183
1902	5,788,322	1,302,468	3,607,759	43,739	13,041,896	162,766	317,963
1903	5,662,975	1,441,809	3,110,044	41,392	12,223,979	....	329,524
1904	5,159,926	1,793,834	2,865,674	42,342	12,110,521	....	313,715
1905	4,988,761	1,721,689	2,428,324	36,947	11,074,759	....	293,716

Year.	Cumberland.	United States.	Producers and Refiners' Pipe Line Company (Limited).	Buckeye-Macksburg.	Total.
1900	....	32,573	1,321,013	5,254,215	35,540,964
1901	131,419	53,722	1,210,457	5,311,239	33,091,120
1902	180,620	73,717	1,819,946	5,064,991	31,404,187
1903	546,263	78,213	2,072,238	5,187,510	30,693,947
1904	985,070	111,939	2,109,513	4,866,137	30,358,671
1905	1,210,821	50,028	2,040,782	4,235,007	28,080,834

PRICES OF APPALACHIAN OILS.

The oils of the Appalachian field are sold under a great many different grades. Fully 90 per cent of the production, however, is graded as Pennsylvania crude. It is the other 10 per cent which is divided up into many grades.

In the following table is given a list of the prices paid by the Seep Purchasing Agency for the different oils of the Appalachian field. The Pennsylvania oil, which received a value of $1.85 on January 1, gradually fell by easy stages until on May 27 it reached the price of $1.27 per barrel. From this time on it gradually rose until on October 20 it was worth $1.61 per barrel, and it closed the year at a price of $1.58. The crude oils of other grades followed, in their respective positions, the movements of the Pennsylvania grade.

Range of prices paid by the Seep Purchasing Agency for light crude petroleum produced in the New York, Ohio, Pennsylvania, and West Virginia oil regions during 1904 and 1905.

[Per barrel of 42 gallons.]

	Tiona, Pa.	Pennsylvania.	Second sand, Pa.	Corning, Ohio.	Newcastle, Ohio.	Cabell, W. Va.
1904.						
January 1	$2.00	$1.85	$1.85	$1.65	$1.72	$1.85
February 12	1.95	1.80	1.80	1.60	1.67	1.55
March 1	1.92	1.77	1.77	1.57	1.64	1.52
March 4	1.89	1.74	1.74	1.54	1.61	1.49
March 12	1.86	1.71	1.71	1.51	1.58	1.46
March 29	1.83	1.68	1.68	1.48	1.55	1.43
April 8	1.80	1.65	1.65	1.45	1.52	1.40
April 29	1.77	1.62	1.62	1.42	1.49	1.37
June 7	1.74	1.59	1.59	1.39	1.46	1.34
June 17	1.72	1.57	1.57	1.37	1.44	1.32
July 2	1.72	1.57	1.57	1.37	1.44	1.57
July 9	1.67	1.52	1.52	1.32	1.39	1.52
July 13	1.65	1.50	1.50	1.30	1.37	1.50
September 1	1.68	1.53	1.53	1.33	1.40	1.53
September 24	1.71	1.56	1.56	1.33	1.43	1.56
November 10	1.75	1.60	1.60	1.37	1.47	1.60
December 16	1.70	1.55	1.45	1.22	1.47	1.30
December 29	1.65	1.50	1.40	1.17	1.42	1.25
1905.						
January 1	1.65	1.50	1.40	1.17	1.42	1.25
January 5	1.60	1.45	1.35	1.12	1.37	1.20
January 11	1.57	1.42	1.32	1.09	1.34	1.17
January 31	1.54	1.39	1.29	1.06	1.31	1.14
March 25	1.51	1.36	1.26	1.03	1.28	1.11
April 12	1.48	1.33	1.23	1.00	1.25	1.08
April 18	1.46	1.31	1.21	.98	1.23	1.06
April 25	1.44	1.29	1.19	.96	1.21	1.04
May 27	1.42	1.27	1.17	.94	1.19	1.02
September 12	1.45	1.30	1.20	.97	1.22	1.05
September 16	1.48	1.33	1.23	1.00	1.25	1.08
September 19	1.51	1.36	1.26	1.03	1.28	1.11
September 22	1.56	1.46	1.26	1.03	1.28	1.11
September 28	1.61	1.51	1.31	1.08	1.33	1.16
October 4	1.66	1.56	1.31	1.08	1.33	1.16
October 20	1.71	1.61	1.41	1.13	1.38	1.21
October 25	1.71	1.61	1.61	1.13	1.38	1.21
November 11	1.68	1.58	1.58	1.10	1.35	1.18

PRICES.

In the following table is given the average price per month of the different oils of New York, Pennsylvania, Ohio, and West Virginia during the years 1904 and 1905:

Average monthly prices of Appalachian crude petroleum in 1904 and 1905.

[Per barrel of 42 gallons.]

Month.	1904.					
	Tiona, Pa.	Pennsylvania.	Second Sand, Pa.	Corning, Ohio.	Newcastle, Ohio.	Cabell, W. Va.
January	$2.00	$1.85	$1.85	$1.65	$1.72	$1.85
February	1.97	1.82	1.82	1.62	1.69	1.67½
March	1.87⅛	1.72⅛	1.72⅛	1.52⅛	1.59⅛	1.47
April	1.80½	1.65½	1.65½	1.45½	1.52½	1.40½
May	1.77	1.62	1.62	1.42	1.49	1.37
June	1.73⅝	1.58⅝	1.58⅝	1.38⅝	1.45⅝	1.33⅝
July	1.67	1.52	1.52	1.32	1.39	1.52
August	1.65	1.50	1.50	1.30	1.37	1.50
September	1.68¾	1.53¾	1.53¾	1.33	1.40¾	1.53¾
October	1.71	1.56	1.56	1.33	1.43	1.56
November	1.73¾	1.58¾	1.58¾	1.35¾	1.45¾	1.58¾
December	1.72	1.57	1.51⅞	1.29	1.46⅜	1.44⅜
Average	1.77¾	1.62¾	1.62¼	1.41½	1.49⅞	1.52⅛

Month.	1905.					
	Tiona, Pa.	Pennsylvania.	Second Sand, Pa.	Corning, Ohio.	Newcastle, Ohio.	Cabell, W. Va.
January	$1.58⅛	$1.43⅛	$1.33⅛	$1.10⅛	$1.35⅛	$1.18⅛
February	1.54	1.39	1.29	1.06	1.31	1.14
March	1.53¼	1.38¼	1.28¼	1.05¼	1.30¼	1.13¼
April	1.47¾	1.32¾	1.22¾	.99¾	1.24¾	1.07¾
May	1.43¾	1.28¾	1.18¾	.95¾	1.20¾	1.03¾
June	1.42	1.27	1.17	.94	1.19	1.02
July	1.42	1.27	1.17	.94	1.19	1.02
August	1.42	1.27	1.17	.94	1.19	1.02
September	1.48⅞	1.35⅜	1.22¼	.99¼	1.24¼	1.07¼
October	1.67½	1.57½	1.39½	1.09⅞	1.34⅞	1.17⅞
November	1.69	1.59	1.59	1.11	1.36	1.19
December	1.68	1.58	1.58	1.10	1.35	1.18
Average	1.53	1.39⅜	1.30⅛	1.02⅜	1.27⅜	1.10⅜

The average monthly and yearly prices per barrel of the crude petroleum in the Appalachian field for the years 1900–1905 are given in the following table:

Monthly and yearly average prices of pipe-line certificates of Pennsylvania crude petroleum at wells in daily market, 1900–1905.

[Per barrel of 42 gallons.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average.
1900	$1.66⅝	$1.68	$1.68	$1.55	$1.39⅜	$1.25½	$1.25⅝	$1.25½	$1.23	$1.10⅜	$1.06¾	$1.08¾	$1.35¼
1901	1.19½	1.25	1.29	1.20½	1.07⅝	1.05	1.13⅜	1.25	1.25⅜	1.30	1.30	1.21	1.21
1902	1.15	1.15	1.15	1.17½	1.20	1.20⅜	1.22	1.22	1.22	1.28⅛	1.38¼	1.49	1.23¾
1903	1.52½	1.50	1.50	1.51	1.51½	1.50	1.52½	1.56	1.57¼	1.68½	1.78¾	1.88⅜	1.59
1904	1.85	1.82	1.72⅛	1.65½	1.62	1.58⅝	1.52	1.50	1.53¾	1.56	1.58¾	1.57	1.62¾
1905	1.43⅛	1.39	1.38⅛	1.32¾	1.28¾	1.27	1.27	1.27	1.35⅜	1.57½	1.59	1.58	1.39⅜

The following table shows the range of prices of Pennsylvania crude oil each year since 1859:

Highest and lowest prices of Pennsylvania crude petroleum each year, 1859–1905.

[Per barrel of 42 gallons.]

Year.	Highest month.	Price.	Lowest month.	Price.
1859	September	$20.00	December	$20.00
1860	January	20.00	December	2.00
1861	January	1.75	December	.10
1862	December	2.50	January	.10
1863	December	4.00	January	2.00
1864	July	14.00	February	3.75
1865	January	10.00	August	4.00
1866	January	5.50	December	1.35
1867	October	4.00	June	1.50
1868	July	5.75	January	1.70
1869	January	7.00	December	4.25
1870	January	4.90	August	2.75
1871	June	5.25	January	3.25
1872	October	4.55	December	2.67½
1873	January	2.75	November	.82½
1874	February	2.25	November	.62½
1875	February	1.82½	January	.75
1876	December	4.23¾	January	1.47½
1877	January	3.69⅜	June	1.53¾
1878	February	1.87½	September	.78¾
1879	December	1.28¾	June	.63⅛
1880	June	1.24⅜	April	.71¼
1881	September	1.01¼	July	.72½
1882	November	1.37	July	.49¼
1883	June	1.24¾	January	.83¼
1884	January	1.15⅝	June	.51¼
1885	October	1.12⅝	January	.68
1886	January	.92¼	August	.59¾
1887	December	.90	July	.54
1888	March	1.00	June	.71⅜
1889	November	1.12½	April	.79¼
1890	January	1.07⅝	December	.60¾
1891	February	.81⅜	August	.50
1892	January	.64⅛	October	.50
1893	December	.80	January	.52⅞
1894	December	.95¾	January	.78½
1895	April	2.60	January	.95¼
1896	January	1.50	December	.90
1897	March	.96	October	.65
1898	December	1.19	January	.65
1899	December	1.66	February	1.13
1900	January	1.68	November	1.05
1901	January, September	1.45	May	.80
1902	December	1.54	January, February, March.	1.15
1903	December	1.90	January, February, March, April, May, June, July.	1.50
1904	January	1.85	July, December	1.50
1905	October	1.61	May	1.27

NEW YORK AND PENNSYLVANIA.

The history of the development of the oil business in the States of New York and Pennsylvania during the year 1905 is an uninteresting and monotonous record. A falling market existed for the oils of the Appalachian field throughout the year 1904 and half through the year 1905. This condition did not encourage the drilling of wild-cat wells nor extensive efforts to maintain and increase production in these States.

During the first part of the year the number of new wells drilled was very small, the resulting increase in production also being small in proportion to the number of wells drilled. With the middle of the year the results of the new wells were somewhat better, but the proportionate number of dry wells continued very large.

The only ripple of excitement which passed over the States during the year was the coming in of a well drilled by Mr. Isaac McBride and others on the farm of Mr. O. K. Walden, situated about 3 miles due west of the city of Butler, in Butler County. This well gave every indication of an old-time gusher. When the bit entered the sand to the extent of two screws, the well began to flow and filled a 250-barrel tank in less than three hours. At the end of a week it was still making a production of 30 barrels an hour and was then capable of being forced by a slight agitation with the tools to a production of 60 barrels an hour. This strike caused a great excitement. There was a rush for adjacent leases, for which large sums were paid in the form of bonuses. The adjacent territory did not, however, sustain the expectations of the operators. A second gusher was obtained some 700 feet to the northeast of the first well, but the other test wells surrounding the original gusher came in as small pumpers or dry, and the total area of producing territory was small.

During the year between 3,700 and 3,800 new wells were drilled in the two States of New York and Pennsylvania. Of these over 22 per cent were dry. The producing wells made an initial daily production of over 12,000 barrels. This quantity did not suffice to overcome the falling off of the old wells, and the total production of the two States shows a decrease of 684,249 barrels from that of 1904.

PRODUCTION.

In the following table is given the total production of petroleum from the States of New York and Pennsylvania, by months, for the year 1905:

Production of crude petroleum in Pennsylvania and New York in 1905, by districts and months.

[Barrels of 42 gallons.]

District.	January.	February.	March.	April.	May.	June.	July.
Pennsylvania:							
Bradford	172,290	147,774	189,193	182,718	186,115	182,686	175,938
Clarendon and Warren	39,545	35,565	37,845	37,340	36,625	35,515	35,725
Tiona	46,372	44,415	50,917	50,003	51,606	48,587	46,379
Lower	289,875	256,357	324,596	295,751	347,709	323,875	308,124
Washington County	91,923	93,016	95,969	92,557	100,621	97,023	94,609
Allegheny County	75,453	67,712	81,436	76,879	82,171	77,466	78,249
Beaver County	29,495	25,414	32,422	28,453	28,837	29,574	22,426
Greene County	41,267	28,479	55,673	42,969	45,390	41,048	37,739
Tioga County	936	1,158	1,222	1,106	1,305	829	1,241
Second Sand	67,799	64,210	85,827	77,527	83,110	80,615	75,298
Franklin	2,083	2,026	5,825	3,951	4,180	3,971	3,367
Total	857,038	766,126	960,925	889,254	967,669	921,189	879,095
New York:							
Allegany	70,035	62,891	79,664	82,468	89,257	82,057	81,963
Total	927,073	829,017	1,040,589	971,722	1,056,926	1,003,246	961,058

Production of crude petroleum in Pennsylvania and New York in 1905, etc.—Continued.

District.	August.	September.	October.	November.	December.	Total.
Pennsylvania:						
Bradford	179,354	176,043	173,342	166,941	182,831	2,115,225
Clarendon and Warren	34,782	34,950	35,310	35,340	35,125	433,667
Tiona	48,180	44,836	46,475	44,096	46,195	568,061
Lower	319,924	292,421	302,271	278,827	308,931	3,648,661
Washington County	96,983	98,364	93,020	96,132	99,319	1,149,536
Allegheny County	76,733	73,857	79,044	73,073	76,151	918,224
Beaver County	25,435	23,697	22,103	21,459	24,008	313,323
Greene County	39,490	36,028	36,160	38,004	31,563	473,810
Tioga County	1,062	1,171	682	722	1,240	12,674
Second Sand	82,885	74,478	76,144	72,961	88,260	929,114
Franklin	4,276	3,605	4,071	3,315	3,448	44,118
Total	909,104	859,450	868,622	830,870	897,071	10,606,413
New York:						
Allegany	83,898	81,112	78,102	76,826	80,091	948,364
Total	993,002	940,562	946,724	907,696	977,162	11,554,777

In the following table will be found a statement of the production of crude petroleum in Pennsylvania and New York, from the years 1896 to 1905, inclusive, by districts:

Production of crude petroleum in Pennsylvania and New York, 1896–1905, by districts.

[Barrels of 42 gallons.]

Year.	Allegany County, N. Y.	Bradford.	Clarendon and Warren.	Middle.	Tioga County.	Second sand.	Tiona.	Lower.
1896	736,606	3,604,771	385,294	956,390			309,252	7,529,807
1897	771,606	3,904,230	378,075	1,329,448			291,585	6,825,599
1898	757,492	3,444,299	414,212	932,000			251,447	5,500,443
1899	807,814	3,206,845	414,352	528,440			212,217	5,080,182
1900	817,326	3,022,493	383,493	452,136	115,105		256,915	5,364,398
1901	765,402	2,757,603	404,433	176,185	37,491		466,909	4,855,049
1902	768,753	2,506,981	468,420	162,762	24,881		421,728	4,754,979
1903	837,312	2,326,413	514,675		19,453		578,122	4,794,520
1904	938,234	2,187,883	520,925		15,904	37,400	608,165	4,822,554
1905	948,364	2,115,225	433,667		12,674	929,114	568,061	3,648,661

Year.	Washington County.	Allegheny County, Pa.	Beaver County.	Greene County.	Franklin.	Smiths Ferry.	Total.
1896	1,975,169	4,380,007	550,296	94,796	49,329	2,704	20,584,421
1897	2,175,712	2,958,540	317,926	258,065	48,880	2,400	19,262,066
1898	1,742,677	2,301,651	220,796	325,177	56,090	2,180	15,948,464
1899	1,460,036	1,988,754	232,154	381,483	61,085	1,150	14,374,512
1900	1,375,341	1,706,886	416,319	588,379	59,036	1,300	14,559,127
1901	1,300,399	1,440,967	799,278	771,708	55,162	1,410	13,831,996
1902	1,396,831	1,376,212	528,734	721,574	50,555	1,200	13,183,610
1903	1,199,838	1,187,496	442,842	567,999	48,209	1,255	12,518,134
1904	1,149,847	1,008,977	358,172	541,356	48,499	1,110	12,239,026
1905	1,149,536	918,224	313,323	473,810	44,118	(a)	11,554,777

[a] Included with Beaver County.

WEST VIRGINIA.

A review of the operation of West Virginia for the year 1905 is a history of diminutions and reductions, with no important points of new discoveries or new developments to enliven the record. There was a great falling off of the efforts put forth for maintaining and increasing the production. During the year 1905 less than 1,700 wells were drilled within the State, as against nearly 2,300 in 1904. The result of this drilling can not be considered satisfactory, as fully 40 per cent of the wells were dry, and the remainder only added a new initial production of some 22,000 barrels. There has been, however, another source of new production which has been very extensively resorted to within the State during the past year. In many districts where wells producing from the upper sand have become exhausted, or nearly so, they were carried down to the lower strata, where they encountered new and good production. These two sources of new production have not been sufficient to counterbalance the gradual decrease in the flow of the wells, and West Virginia during 1905 showed a falling off of 1,066,576 barrels, or 8.4 per cent, as compared with the year 1904.

PRODUCTION.

In the following table is shown the production of crude petroleum, by kinds and by months, in West Virginia for the year 1905:

Production of crude petroleum in West Virginia in 1905, by kinds and months.

[Barrels.]

Month.	Regular crude.	Cabell district.	Natural lubricating.	Total.
January	936,571	3,738	....	940,709
February	919,551	3,681	....	923,632
March	1,089,811	2,896	....	1,093,107
April	965,801	4,339	....	970,540
May	1,073,784	4,700	....	1,078,884
June	1,021,231	4,938	....	1,026,569
July	947,438	5,081	....	952,919
August	991,827	4,129	....	996,356
September	907,434	3,749	....	911,583
October	898,819	2,725	....	901,944
November	856,916	2,475	....	859,791
December	920,183	1,728	....	922,076
Total	11,529,366	44,179	4,565	11,578,110

The production of crude petroleum in West Virginia by months, from 1900 to 1905, is shown in the following table:

Total production of crude petroleum in West Virginia, by months, 1900–1905.

[Barrels of 42 gallons.]

Month.	1900.	1901.	1902.	1903.	1904.	1905.
January	1,263,727	1,280,469	1,101,059	1,096,871	983,735	940,709
February	1,147,607	1,117,091	952,735	979,733	957,655	923,632
March	1,318,116	1,202,143	1,088,820	1,135,037	1,094,074	1,093,107
April	1,287,860	1,184,054	1,118,337	1,103,825	1,037,305	970,540
May	1,400,524	1,232,787	1,145,916	1,108,373	1,091,552	1,078,884
June	1,388,802	1,157,864	1,078,491	1,111,348	1,073,520	1,026,569
July	1,431,416	1,244,396	1,200,647	1,144,568	1,082,261	952,919
August	1,439,617	1,280,829	1,151,817	1,065,183	1,144,686	996,356
September	1,353,694	1,113,156	1,230,484	1,064,612	1,056,336	911,583
October	1,463,561	1,185,178	1,237,359	1,090,579	1,023,350	901,944
November	1,356,321	1,077,529	1,084,132	960,106	1,026,169	859,791
December	1,344,430	1,101,630	1,123,548	1,039,160	1,074,043	922,076
Total	16,195,675	14,177,126	13,513,345	12,899,395	12,644,686	11,578,110

The quantity and value of crude petroleum produced in West Virginia from 1900 to 1905, inclusive, is shown in the following table:

Quantity and value of crude petroleum produced in West Virginia, 1900–1905.

Year.	Regular crude.			Lubricating crude.			Total.		
	Quantity.	Value.	Price per barrel.	Quantity.	Value.	Price per barrel.	Quantity.	Value.	Price per barrel.
	Barrels.			*Barrels.*			*Barrels.*		
1900	16,176,757	$21,879,064	$1.35¼	18,918	$43,638	$2.307	16,195,675	$21,922,702	$1.353
1901	14,164,662	17,139,241	1.21	12,464	33,483	2.687	14,177,126	17,172,724	1.211
1902	13,498,685	17,006,469	1.26	14,660	33,848	2.309	13,513,345	17,040,317	1.261
1903	12,893,079	20,499,996	1.59	6,316	16,536	2.62	12,899,395	20,516,532	1.59
1904	12,636,253	20,557,556	1.627	8,433	26,225	3.11	12,644,686	20,583,781	1.628
1905	11,573,545	16,117,816	1.3926	4,565	14,815	3.25	11,578,110	16,132,631	1.3934

KENTUCKY AND TENNESSEE.

These two States on the southern limit of the Appalachian field present the most probable area from which an increased production of the Appalachian field may be obtained. Both of these States made an increase in their production in 1905 over 1904. Kentucky shows an increase of 205,214 barrels, and Tennessee an increase of 7,323 barrels. This increase in production comes almost entirely from the further development of pools already discovered. The greater portion of the Kentucky increase comes from Wayne County, where a fair amount of development work was carried on through the full year and considerable new producing area was added to the Cooper and Steubenville pools.

Next to Wayne County the most interest was taken in Wolf County, the deep sand district of the State, where the oil is obtained at a depth of 1,400 to 1,500 feet. Considerable prospecting extended into Morgan County on the north.

The production of heavy oil from Barren County remained about the same as in previous years.

During February the Cumberland pipe line was extended into the Poplar Cove development of Fentress County, in Tennessee.

PRODUCTION, STOCKS, AND PRICES.

The production of oil in Kentucky and Tennessee for the years 1900–1905, inclusive, is as follows:

Production of petroleum in Kentucky and Tennessee, 1900–1905.

Year	Barrels.
1900	[a] 62,259
1901	137,259
1902	185,331
1903	554,286
1904	998,284
1905	1,217,337
Total	3,154,756

[a] Includes 41,405 barrels sold in 1900 but produced in previous years.

Production of crude petroleum in Kentucky and Tennessee, 1901–1905, by months.

[Barrels.]

Month.	1901.	1902.	1903.	1904.	1905.
January	5,220	11,947	82,654	53,631	77,569
February	3,462	10,847	27,525	52,650	71,355
March	3,851	9,771	32,024	61,762	103,315
April	3,387	10,679	28,766	65,502	100,508
May	4,510	11,944	30,433	86,615	114,702
June	11,007	10,397	53,744	99,447	118,181
July	6,761	10,118	35,996	95,501	117,452
August	13,265	18,351	40,954	101,216	109,562
September	18,708	18,188	67,123	97,444	106,469
October	21,716	17,628	59,932	98,939	101,559
November	26,391	20,621	46,735	92,356	93,817
December	18,981	34,840	48,400	93,221	102,848
Total	137,259	185,331	554,286	998,284	1,217,337

Stocks of petroleum in Kentucky and Tennessee, 1900–1905.

Year	Barrels.
1900	61,117
1901	134,570
1902	[a] 279,493
1903	[a] 408,378
1904	[a] 321,867
1905	[a] 216,609

[a] Stocks held by pipe-line company.

The following is the report of the Cumberland Pipe Line Company for the years 1904 and 1905:

Report of Cumberland Pipe Line Company, Kentucky, by districts and months, in 1904 and 1905.

[Barrels.]

Month.	1904.			1905.		
	Somerset.	Ragland.	Total.	Somerset.	Ragland.	Total.
January	34,828	17,703	52,531	65,823	11,190	77,013
February	37,065	14,485	51,550	59,837	11,118	70,955
March	42,457	18,205	60,662	89,383	13,376	102,759
April	47,834	16,568	64,402	88,634	11,474	100,108
May	69,222	16,293	85,515	102,286	11,860	114,146
June	82,453	15,894	98,347	105,281	12,500	117,781
July	82,632	11,769	94,401	105,675	11,065	116,740
August	84,638	15,478	100,116	98,757	10,093	108,850
September	82,452	13,892	96,344	96,477	9,436	105,913
October	83,144	14,695	97,839	90,711	10,448	101,159
November	78,309	12,947	91,256	84,630	8,475	93,105
December	77,438	14,669	92,107	93,709	8,583	102,292
Total	802,472	182,598	985,070	1,081,203	129,618	1,210,821

Report of Cumberland Pipe Line Company, Kentucky, in 1905, by States and months.

[Barrels.]

Month.	Kentucky.	Tennessee.	Total.
January	77,013	....	77,013
February	70,473	482	70,955
March	99,669	3,090	102,759
April	98,724	1,384	100,108
May	112,744	1,402	114,146
June	117,010	771	117,781
July	115,912	828	116,740
August	108,470	380	108,850
September	105,288	625	105,913
October	100,786	373	101,159
November	92,592	513	93,105
December	102,292	....	102,292
Total	1,200,973	9,848	1,210,821

In the following table are given the average monthly prices of Kentucky and Tennessee crude petroleum, per barrel of 42 gallons, in the years 1901 to 1905, inclusive:

Average monthly prices, per barrel, of Kentucky and Tennessee crude petroleum in 1901–1905.

Month.	1901.			1902.		1903.		1904.	1905.
	White-house.	Somer-set.	Lacy.	White-house.	Somer-set, Lacy.	White-house.	Somer-set, Lacy.	White-house, Somer-set, Lacy.	White-house, Somer-set, Lacy.
January	$0.89½	$0.82¼	$0.69	$0.85	$0.69	$1.22½	$0.97½	$1.30	$0.84⅜
February	.95	.86	.69	.85	.69	1.20	.95	1.27	.80
March	.99	.88½	.69	.85	.69	1.20	.95	1.17⅛	.80
April	.90½	.83¼	.69	.87½	.70½	1.21	.95⅝	1.10½	.78
May	.77⅝	.75½	.69	.90	.72	1.21½	.96	1.07	.75⅞
June	.75	.74	.69	.90⅜	.72⅛	1.20	.95	1.03⅝	.75
July	.83⅜	.79	.69	.92	.73	1.22½	.96¾	.97	.75
August	.95	.86	.69	.92	.73	1.26	.99	.95	.75
September	.95⅜	.85¼	.69¾	.92	.73	1.26⅛	.99¼	.98¾	.78⅜
October	1.00	.78	.78	.98⅛	.77⅜	1.34⅜	1.19½	1.01	.87½
November	1.00	.78	.78	1.08¼	.84½	1.35	1.28	1.01	.89¾
December	.91	.72⅝	.72⅝	1.19	.94	1.34⅜	1.32¼	.98	.89
Average	.91	.80¾	.70⅞	.93¾	.74¾	1.25¼	1.04	1.07⅛	.80⅔

Month.	1902.			1903.			1904.			1905.
	Barboursville.		Rag-land.	Barboursville.		Rag-land.	Barboursville.		Rag-land.	Rag-land.
	Light.	Heavy.		Light.	Heavy		Light.	Heavy.		
January				$0.97½	$0.55	$0.55	$1.30	$0.66	$0.66	$0.55⅞
February				.95	.55	.55	1.27	.63	.63	.53
March				.95	.55	.55	1.17⅛	.66	.66	.53
April				.95⅝	.55⅝	.55⅝	1.10½	.66	.66	.51¼
May				.96	.60	.60	1.07	.66	.66	.49⅞
June				.95	.62	.62	1.03⅝	.66	.66	.49
July				.96¾	.62	.62	.97	.60¼	.60¼	.49
August				.99	.62	.62	.95	.58	.58	.49
September				.99¼	.62¼	.62¼	.98¾	.60	.60	.49
October				1.19½	.65¼	.65¼	1.01	.60	.60	.49
November				1.28	.66	.66	1.01	.60	.60	.49
December	$0.95⅜	$0.55	$0.55	1.32¼	.66	.66	.98	.59⅞	.59⅞	.49
Average	.95⅜	.55	.55	1.04	.60½	.60½	1.07⅛	.62⅝	62⅝	.50½

Fluctuations in prices, per barrel, of Kentucky and Tennessee crude petroleum in 1904 and 1905.

1904.	Whitehouse, Somerset, Lacy, Barboursville (light).	Barboursville (heavy), Ragland.	1905.	Whitehouse, Somerset, Lacy, Barboursville (light).	Barboursville (heavy), Ragland.
January 1	$1.30	$0.66	January 1	$0.91	$0.58
February 12	1.25	.61	January 5	.86	.58
March 1	1.22	.66	January 11	.83	.55
March 4	1.19	.66	January 31	.80	.53
March 12	1.16	.66	April 12	.78	.51
March 29	1.13	.66	April 18	.77	.50
April 8	1.10	.66	April 25	.76	.50
April 29	1.07	.66	May 27	.75	.49
June 7	1.04	.66	September 12	.77	.49
June 17	1.02	.66	September 16	.79	.49
July 9	.97	.61	September 19	.81	.49
July 13	.95	.58	September 28	.83	.49
September 1	.98	.60	October 13	.89	.49
September 24	1.01	.60	October 20	.91	.49
December 16	.96	.60	November 11	.89	.49
December 29	.91	.58			

OHIO.

SOUTHEASTERN OHIO.

Southeastern Ohio, like the States already considered in the Appalachian field, showed a marked falling off in the efforts for the maintenance of the production during the year 1905. There were between 1,700 and 1,800 wells drilled, as against 2,300 in 1904. Of these wells 38 per cent were dry. A total new initial production of about 13,000 barrels was obtained during the year. This did not counterbalance the falling off of the old wells. The production of the southeastern portion of the State decreased 509,835 barrels, or 9.22 per cent, as compared with the production of 1904.

A few small pools were discovered during the year, and some extensions were found to already existing developments.

The Bluck pool, between the forks of Wills Creek, in Jefferson County, furnished a number of fair producing wells. The small pool at Amsterdam, in Jefferson County, which had previously only furnished wells with small initial flow, was extended in a southerly direction by wells of considerable size, some starting as high as 100 barrels a day.

In Monroe County, east of Woodsfield, a production in the Berea sandstone was developed during the year.

A considerable extension in a southwesterly direction was added to the Adams pool, in Harrison County.

During the last part of the year two occurrences of oil were obtained in the development of eastern Ohio that are worthy of particular note, not so much from the quantity of oil produced as from the fact that the oil was found in formations not previously producing oil in that locality. The first of these was near Akron, Ohio, where the Interstate Oil Company drilled a well on the Brewster farm. This resulted in a pumper yielding from 20 to 25 barrels. The oil was produced from a limestone at a depth of about 2,645 feet. The second well drilled by the Interstate Oil Company, a mile from the producing well, resulted in a dry hole. Another well drilled in this locality by Mr. R. G. Gillespie resulted in a very small pumper. The production from these wells amounts to little or nothing, but this find may result in the opening up of a new limestone area.

Two miles east of Butler, in Worthington Township, Richland County, a well drilled for gas produced oil from the Clinton rock at a depth of 2,600 feet. The oil was of light amber color, and 49° Baumé gravity. The well flowed from 40 to 50 barrels per day.

Production.—In the following table is shown the total production of crude petroleum from Ohio. This table gives not only the production from southeastern Ohio, but also from the Lima field in northwestern Ohio.

Total production of crude petroleum in Ohio in 1905, by months and districts.

[Barrels of 42 gallons.]

Month.	Lima.	Southeastern Ohio.	Mecca-Belden.	Total.
January	1,012,155	422,835		1,434,990
February	834,152	383,655		1,217,807
March	1,075,987	448,502	25	1,524,514
April	952,394	402,391		1,354,785
May	1,020,999	435,292	25	1,456,316
June	1,001,527	422,387		1,423,914
July	921,885	403,241	40	1,325,166
August	970,540	424,817		1,395,357
September	887,608	400,283		1,287,891
October	883,957	425,786		1,309,743
November	880,844	407,543		1,288,387
December	887,876	439,914		1,327,790
Total	11,329,924	5,016,646	90	16,346,660

The total quantity and value of crude petroleum produced in Ohio from 1900 to 1905, inclusive, by districts, are shown in the following table:

Total quantity and value of crude petroleum produced in Ohio, 1900–1905.

[Barrels.]

Year.	Lima district.		Southeastern Ohio district.		Mecca-Belden district.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1900	16,884,358	$16,673,304	5,476,089	$7,406,734	2,283	$11,563	22,362,730	$24,091,601
1901	16,176,293	13,911,612	5,470,850	6,619,342	940	2,617	21,648,083	20,533,571
1902	15,877,730	14,284,072	5,136,366	6,471,821	135	1,466	21,014,231	20,757,359
1903	14,893,853	17,351,339	5,585,858	8,881,514	575	1,668	20,480,286	26,234,521
1904	13,350,060	14,735,129	5,526,146	8,993,803	425	1,583	18,876,631	23,730,515
1905	11,329,924	10,061,992	5,016,646	6,991,950	90	935	16,346,660	17,054,877

In the following table are given the production and value of the crude petroleum in the Mecca-Belden district from 1900 to 1905, inclusive:

Production and value of crude petroleum in the Mecca-Belden district of Ohio, 1900–1905.

Year.	Belden district, Lorain County.			Mecca district, Trumbull County.			Total.		
	Quantity.	Value.	Price per barrel.	Quantity.	Value.	Price per barrel.	Quantity.	Value.	Price per barrel.
	Barrels.			*Barrels.*			*Barrels.*		
1900	2,100	$9,770	$4.65	183	$1,793	$9.80	2,283	$11,563	$5.07
1901	830	1,255	1.51	110	1,362	12.38	940	2,617	2.78
1902	55	193	3.50	80	1,273	15.91	135	1,466	10.85
1903	550	1,300	2.36	25	368	14.70	575	1,668	2.90
1904	362	620	1.71	63	963	15.28	425	1,583	3.73
1905	40	148	3.70	50	787	15.74	90	935	10.39

NORTHWESTERN OHIO.

The Trenton rock oil fields of northwestern Ohio showed a falling off in the number of wells drilled during the year 1905 of nearly 50 per cent as compared with 1904. The percentage of dry wells was not greatly in excess of previous years, being 9.6 per cent of the wells drilled. The successful wells furnished an initial daily production of nearly 16,000 barrels. This was not sufficient to maintain the former production from the field, and it was less in 1905 by 2,020,136 barrels than in 1904.

A falling off of the field work to this extent is an evidence of no new finds of importance. A little new territory was added in Ottawa County, between the Four-Mile House pool and Oak Harbor. The rest of the development was almost entirely within already defined limits.

At the close of the year 1905 there were 26,523 wells producing oil in northwestern Ohio that were connected to the Buckeye Pipe Line.

Line of North and South Lima oil field.—The imaginary line which divides the district from which oil is graded as North Lima and South Lima oil was changed by the Buckeye Pipe Line on September 22, 1905. The new line was given the following description:

Commencing 1 mile south of the center of Union Township, Hancock County (southwest corner of section 19), thence east along this section line through Union, Eagle, and Jackson townships to the southeast corner of section 19, Alameda Township; thence south along the west line of Richmond Township, Wyandot County, to the southwest corner of said township; thence east along the south line of Richland, Salem, Crane, and Eden townships, Wyandot County.

The object of this change was probably to carry the line through a less productive territory. In doing so an area of 14½ square miles was taken from the South Lima and added to the North Lima district.

Production.—In the following table is found the production of petroleum in the Lima (Ohio) field from 1900 to 1905, by months:

Production of petroleum in the Lima (Ohio) district, 1900–1905, by months.

[Barrels of 42 gallons.]

Year.	January.	February.	March.	April.	May.	June.
1900	1,372,219	1,180,596	1,360,672	1,381,527	1,476,472	1,483,632
1901	1,384,966	1,182,712	1,331,346	1,345,660	1,410,056	1,349,140
1902	1,386,887	1,165,557	1,344,816	1,306,409	1,377,416	1,313,203
1903	1,279,590	1,092,532	1,270,382	1,258,562	1,270,621	1,295,036
1904	1,052,538	975,837	1,177,246	1,135,368	1,169,903	1,183,973
1905	1,012,155	834,152	1,075,987	952,394	1,020,999	1,001,527

Year.	July.	August.	September.	October.	November.	December.	Total.
1900	1,492,396	1,531,082	1,404,262	1,504,753	1,339,088	1,357,659	16,884,358
1901	1,381,557	1,376,697	1,345,858	1,440,467	1,353,232	1,274,602	16,176,293
1902	1,392,750	1,370,641	1,336,394	1,370,811	1,260,818	1,252,028	15,877,730
1903	1,316,229	1,261,054	1,262,313	1,252,247	1,151,042	1,184,245	14,893,853
1904	1,138,213	1,185,833	1,116,707	1,088,749	1,066,894	1,058,799	13,350,060
1905	921,885	970,540	887,608	883,957	880,844	887,876	11,329,924

In the following table is given the total production of crude petroleum in Ohio for the years 1900 to 1905, by months:

Total production of crude petroleum in Ohio, 1900–1905, by months.

[Barrels of 42 gallons.]

Year.	January.	February.	March.	April.	May.	June.
1900	1,797,011	1,561,743	1,785,065	1,790,735	1,956,327	1,938,838
1901	1,873,389	1,602,106	1,809,767	1,779,797	1,903,559	1,795,308
1902	1,808,810	1,522,246	1,741,259	1,730,214	1,826,835	1,732,538
1903	1,756,453	1,491,586	1,749,906	1,736,347	1,749,483	1,797,149
1904	1,486,054	1,385,072	1,630,578	1,578,786	1,652,285	1,653,844
1905	1,434,990	1,217,807	1,524,514	1,354,785	1,456,316	1,423,914

Year.	July.	August.	September.	October.	November.	December.	Total.
1900	1,964,068	2,046,456	1,878,231	2,005,123	1,798,763	1,840,370	22,362,730
1901	1,857,470	1,865,712	1,783,589	1,900,641	1,773,549	1,703,196	21,648,083
1902	1,847,675	1,818,152	1,757,001	1,830,990	1,705,903	1,692,608	21,014,231
1903	1,813,618	1,726,557	1,739,082	1,709,003	1,576,048	1,635,054	20,480,286
1904	1,623,389	1,704,703	1,619,421	1,547,756	1,504,352	1,490,391	18,876,631
1905	1,325,166	1,395,357	1,287,891	1,309,743	1,288,387	1,327,790	16,346,660

Prices.—In the following table will be found the highest, lowest, and average prices of Lima (Ohio) oil for the last six years:

Highest, lowest, and average prices of Lima (Ohio) crude petroleum, 1900–1905.

Year.	Highest.	Lowest.	Average.	Year.	Highest.	Lowest.	Average.
1900	[a]$1.26	[b]$0.74	$0.98¾	1903	[a]$1.33	[b]$1.06	$1.16½
1901	[a].94	[b].74	.86	1904	[a]1.36	[b].95	1.10⅜
1902	[a]1.15	[b].80	.88¼	1905	[a]1.01	[b].81	.88¾

[a] North Lima. [b] South Lima.

LIMA-INDIANA AND ILLINOIS FIELD.

Illinois, which has come into prominence as an oil-producing State during the year 1905, has been added to the Lima-Indiana field by reason of its geographical location. It is probable that this State might better, for geological reasons, have been added to the Mid-Continent field. The horizon from which the oil is produced is nearly the same as that which produces oil in Kansas and Indian Territory, while the greater part of the production of the Lima-Indiana field comes from rocks that in the geological column are far below the sandstone beds of either the Appalachian or the Mid-Continent field.

Over 90 per cent of the production of the Lima-Indiana field comes from the Trenton limestone of the Ordovician system. This limestone is from 400 to 600 feet in thickness. It is only from certain portions that oil is produced in commercial quantities. The general mass of the Trenton limestone is too compact to permit the rapid passage of oil and gas through it, or to form a suitable reservoir for large quantities of these fluids. When deposited this limestone was probably a true calcium carbonate ($CaCO_3$), in some places very pure and in others more or less mixed with silica or other impurities. Portions of the limestone have become changed into dolomite. This has taken place, probably, by change in surface conditions which brought the limestone adjacent to waters heavily charged with magnesium salts in the form of chloride of magnesia. Under this condition a chemical change took place in the Trenton limestone, and it was made into a dolomite, a calcium-magnesium carbonate. The chemical change is represented by the formula: $2CaCO_3+M_gCl_2=CaM_g2CO_3+CaCl_2$. The importance of this change to the oil and gas is in the fact that the rock as dolomite does not occupy the full space filled by the rock as true limestone. Each crystal of dolomite occupies less space than it did as a crystal of lime. Therefore between each is a void which gives space for gas, oil, and water and allows the rapid flow of the liquids through the limestone.

The portion of the limestone which was thus changed into dolomite is small compared with the full thickness of the stratum. Until the year 1903 these pay streaks, as they are called, were thought to be entirely within the first hundred feet of the limestone. They usually consisted of two layers, the first from 4 to 12 feet in thickness and lying within 20 feet of the top of the Trenton. The second streak is some 20 feet below the first, and separated from it by limestone in its original form. Later developments have shown another pay streak to exist in Grant and Delaware counties in Indiana from 280 to 300 feet from the top of the limestone, and this may become in the future a source of large quantities of petroleum.

The structure or relative elevation of the limestone is found to be the governing factor in the accumulation of the hydrocarbons. The porous portion of the limestone is completely saturated in the lowest places with salt water, the oil being directly above the water and the gas filling the higher domes.

Throughout the area of the field the surface conditions are not favorable for determining the geologic structure in advance of the drill. The full area is a drift-covered plane in which but few stream beds have been eroded down to solid rock formations. So few outcrops of rock come within the oil fields that no valuable information can be obtained from them. By the recorded depth of the drill holes in connection with the elevation of the mouths of the wells some data relative to the geologic structure have been accumulated. Enough of this information has not been compiled, however, to give more than a general idea of the structural conditions.

The crude petroleum obtained from the Trenton limestone is a brownish-black liquid with a specific gravity of about 0.85 or 35° of the Baumé scale. It possesses a rank disagreeable odor due to the sulphur compounds which it contains. It is a complex mixture of hydrogen and carbon, with a small amount of nitrogen and sulphur.

Oils from other horizons than the Trenton limestone have been produced in the Lima-Indiana and Illinois field for a number of years, but in very small quantities prior to the year 1905. At Terre Haute, Ind., a well has been producing steadily for fifteen years from the Corniferous limestone. The oil is similar in quality to that produced from the Trenton limestone. In Jasper County also the Corniferous limestone produces a natural lubricating oil. The following is an analysis of this oil:

Analysis of crude petroleum from the Jasper County, Ind., oil field.

[Marimer and Hoskins, Chicago, analysts.]

Specific gravity	0.928 or 20.8° Baumé
Cold test	7° F.
Flashing point	410° F.
Fire test	437° F.
Sulphur	1.26 per cent
Asphaltic matter	2.90 per cent

PRODUCTION OF LIMA-INDIANA AND ILLINOIS FIELD.

In the following table will be found the production from the Lima-Indiana and Illinois field, by States and months, for the year 1905:

Production of crude petroleum in the Lima-Indiana and Illinois oil field in 1905, by months.

[Barrels.]

Month.	Lima, Ohio.	Indiana.	Illinois.	Total.
January	1,012,155	1,043,535		2,055,690
February	834,152	808,790		1,642,942
March	1,075,987	1,043,950		2,119,937
April	952,394	970,045		1,922,439
May	1,020,999	1,018,260		2,039,259
June	1,001,527	1,017,220	6,521	2,025,268
July	921,885	944,433	17,306	1,883,624
August	970,540	924,048	23,827	1,918,415
September	887,608	847,671	26,586	1,761,865
October	883,957	799,478	27,589	1,711,024
November	880,844	771,757	34,611	1,687,212
December	887,876	775,060	44,644	1,707,580
Total	11,329,924	10,964,247	181,084	22,475,255

In the following table will be found the production from the Lima-Indiana and Illinois field from 1886 to 1905, inclusive, with its percentage of the total production of the United States, the increase or decrease made each year, and the percentage of increase or decrease:

Production of petroleum in the Lima (Ohio)-Indiana, and Illinois field, 1886–1905.

[Barrels.]

Year.	Production.	Percentage of total production.	Increase.	Decrease.	Percentage.	
					Increase.	Decrease.
1886	1,137,869	4.05				
1887	4,650,375	16.44	3,512,506		308.69	
1888	9,682,683	35.07	5,032,308		108.21	
1889	12,188,024	34.66	2,505,341		25.87	
1890	15,079,278	32.90	2,891,254		23.72	
1891	17,453,287	32.15	2,374,009		15.74	
1892	15,868,096	31.41		1,585,191		9.08
1893	15,982,497	33.00	114,401		.72	
1894	17,296,810	35.05	1,314,313		8.22	
1895	20,236,941	38.26	2,940,131		17.00	
1896	25,256,120	41.43	5,019,179		24.80	
1897	22,805,533	37.71		2,450,587		9.70
1898	20,321,683	36.71		2,483,850		10.89
1899	20,225,716	35.44		95,967		.47
1900	21,758,950	34.20	1,533,234		7.58	
1901	21,933,629	31.61	174,679		.80	
1902	23,358,826	26.31	1,425,197		6.50	
1903	24,080,264	23.97	721,438		3.09	
1904	24,689,184	21.09	608,920		2.53	
1905	22,475,255	16.68		2,213,929		8.97

PIPE-LINE RUNS, SHIPMENTS, AND STOCKS.

In the following table will be found the runs, shipments, and stocks at the end of each month of all the principal pipe-line companies operating in the Lima-Indiana and Illinois field during the year 1905:

Pipe-line runs, shipments, and stocks in Lima-Indiana and Illinois field in 1905, by months.

[Barrels.]

Month.	Runs.	Shipments.	Stocks.
January	1,969,558	2,129,890	14,919,940
February	1,572,352	2,051,689	14,514,266
March	2,027,009	2,265,119	14,449,688
April	1,834,860	2,187,235	14,233,636
May	1,937,725	2,031,875	14,332,002
June	1,922,393	2,104,442	14,345,937
July	1,772,014	2,103,921	14,210,395
August	1,795,429	2,064,112	14,128,874
September	1,644,874	2,089,689	13,858,504
October	1,588,509	2,459,437	13,284,119
November	1,550,538	2,064,089	13,014,210
December	1,552,337	2,147,435	12,637,117
Total	21,167,598	25,698,933	

PRICES OF CRUDE PETROLEUM IN LIMA-INDIANA FIELD.

In the following table are given the average monthly prices of Lima (Ohio) and Indiana crude petroleum, per barrel of 42 gallons each, in the years 1903 to 1905.

Average monthly prices of Ohio and Indiana crude petroleum in 1903, 1904, and 1905.

[Per barrel of 42 gallons.]

Month.	1903.		1904.		1905.	
	North Lima.	South Lima and Indiana.	North Lima.	South Lima and Indiana.	North Lima.	South Lima and Indiana.
January	$1.13½	$1.08½	$1.36	$1.31	$0.96¼	$0.91¼
February	1.11	1.06	1.33	1.28	.93	.88
March	1.11½	1.06½	1.23⅛	1.18⅛	.92½	.87½
April	1.14⅝	1.09⅝	1.16½	1.11½	.89	.84
May	1.15	1.10	1.13	1.08	.86⅞	.81⅞
June	1.14	1.09	1.10	1.05	.86	.81
July	1.15¾	1.10¾	1.02¼	.97¼	.86	.81
August	1.18	1.13	1.00	.95	.86	.81
September	1.18⅜	1.13⅜	1.03½	.98½	.89⅜	.84⅜
October	1.26½	1.21½	1.05	1.00	.94⅞	.89⅞
November	1.33	1.28	1.06⅜	1.01⅜	.94¾	.89¾
December	1.37⅜	1.32⅜	1.05⅛	1.00⅛	.94	.89
Average	1.19	1.14	1.12⅞	1.07⅞	.90¾	.85¾
Average of North Lima, South Lima, and Indiana	1.16½		1.10⅜		.88¾	

In the following table are given the fluctuations in prices for the various grades of Lima and Indiana oil in 1903, 1904, and 1905. The dates are those on which changes in prices were made.

Fluctuations in prices of Lima (Ohio) and Indiana crude petroleum in 1903, 1904, and 1905.

Date.	1903.		Date.	1904.		Date.	1905.	
	North Lima.	South Lima and Indiana.		North Lima.	South Lima and Indiana.		North Lima.	South Lima and Indiana.
January 1	$1.15	$1.10	January 1	$1.36	$1.31	January 1	$1.01	$0.96
January 21	1.13	1.08	February 12	1.31	1.26	January 5	.98	.93
January 22	1.11	1.06	March 1	1.28	1.23	January 11	.95	.90
March 26	1.14	1.09	March 4	1.25	1.20	January 31	.93	.88
April 22	1.16	1.11	March 12	1.22	1.17	March 25	.91	.86
May 16	1.14	1.09	March 29	1.19	1.14	April 12	.89	.84
July 16	1.16	1.11	April 8	1.16	1.11	April 18	.88	.83
July 23	1.18	1.13	April 29	1.13	1.08	April 25	.87	.82
September 28	1.20	1.15	June 7	1.11	1.06	May 27	.86	.81
September 30	1.22	1.17	June 17	1.08	1.03	September 12	.88	.83
October 9	1.24	1.19	July 9	1.03	.98	September 16	.90	.85
October 13	1.26	1.21	July 13	1.00	.95	September 19	.92	.87
October 17	1.28	1.23	September 1	1.03	.98	September 28	.94	.89
October 24	1.30	1.25	September 24	1.05	1.00	October 20	.96	.91
October 28	1.32	1.27	November 10	1.07	1.02	November 11	.94	.89
November 20	1.35	1.30	December 16	1.04	.99			
December 2	1.37	1.32	December 29	1.01	.96			
December 9	1.38	1.33						
December 29	1.36	1.31						

INDIANA.

The field developments of Indiana show a falling off all along the line. The total number of wells drilled within the State in 1905 was but little over 50 per cent of those drilled in 1904. The average initial production of the wells showed but a slight falling off from previous years. The total new initial production added was about 34,000 barrels. This did not counterbalance the falling off in the production of the old wells, the total yield for the State being 374,877 barrels less than in the year 1904.

Indiana has very strict and valuable laws relative to the waste of its natural gas resources. In that State gas can not be allowed to waste during the production of oil. This legislation, excellent as it is, has held back the oil development in a large portion of the State. The pressure of the gas area is rapidly diminishing within this district, and in all probability considerable area which has previously been gas area will be turned into oil-producing territory within the next few years.

The developments in the field have been mostly within Delaware, Grant, and Jay counties.

At the end of the year 1905 there were 14,786 wells connected with the Buckeye Pipe Line in the State of Indiana.

PRODUCTION.

In the following table are shown the production and value of the oil produced in the State of Indiana during the years 1904 and 1905.

Production and value of petroleum in Indiana in 1904 and 1905, by kinds.

[Barrels.]

Kind.	1904.		1905.	
	Quantity.	Value.	Quantity.	Value.
Trenton rock	11,317,259	$12,208,493	10,951,407	$9,390,832
Corniferous rock	9,265	10,981	8,750	9,897
Lubricating (natural)	12,600	16,200	4,090	4,180
Total	11,339,124	12,235,674	10,964,247	9,404,909

In the following table will be found the production of petroleum in Indiana from the year 1900 to 1905, by months.

Total production of petroleum in Indiana, 1900–1905, by months.

[Barrels of 42 gallons.]

Year.	January.	February.	March.	April.	May.	June.	July.
1900	314,899	294,960	364,349	376,753	427,773	446,854	438,313
1901	427,560	387,135	435,518	449,562	484,587	484,740	508,571
1902	549,131	468,416	559,363	584,796	633,821	629,058	685,510
1903	653,837	571,072	727,566	682,982	752,811	811,258	832,758
1904	725,642	671,063	800,674	801,796	872,233	933,225	1,006,209
1905	1,043,535	808,790	1,043,950	970,045	1,018,260	1,017,220	944,433

Year.	August.	September.	October.	November.	December.	Total.	Average.
1900	467,586	420,106	469,483	409,182	444,134	4,874,392	406,199
1901	525,974	522,060	535,694	513,248	482,437	5,757,086	479,757
1902	689,192	663,177	717,445	661,588	639,399	7,480,896	623,408
1903	840,320	859,215	874,742	779,895	799,955	9,186,411	765,534
1904	1,084,457	1,118,513	1,142,980	1,133,274	1,049,058	11,339,124	944,927
1905	924,048	847,671	799,478	771,757	775,060	10,964,247	913,687

In the following table will be found a statement of the production of petroleum in Indiana from 1900 to 1905:

Production of petroleum in Indiana, 1900–1905.

[Barrels.]

Year.	Quantity.	Total value at wells of all oil produced, excluding pipeage.	Price per barrel.
1900	4,874,392	$4,693,983	$0.96
1901	5,757,086	4,822,826	.838
1902	7,480,896	6,526,622	.87
1903	9,186,411	10,474,127	1.14
1904	11,339,124	12,235,674	1.08
1905	10,964,247	9,404,909	.858

ILLINOIS.

During the year 1905 the State of Illinois joined the ranks of oil-producing States of importance. Prior to this time there had been a small production of a heavy oil, valuable for lubricating purposes, produced from a few wells at Litchfield, Montgomery County. This production was small, amounting to but a few hundred barrels each year.

During the time of the early oil excitement in Pennsylvania, some wells were drilled in Clark County, Ill., a few miles north of the town of Casey, at a place called Oil Field. These wells are reported to have made a small showing of oil, but never any commercial production. During the summer of 1904 this old field was taken up by Pittsburg parties, and a well was drilled very close to the former tests. The first well made a slight showing of both oil and gas. This was followed by a second test a short distance to the west, which resulted in a well good for 35 barrels a day. From this commencement the field has extended to the north and south through Clark to Cumberland and Crawford counties. The productive area seems to have a trend of a few degrees west of north and has an approximate length of 36 miles. The width of the belt varies quite considerably, but averages from 10 to 12 miles. There are three principal localities where the development has been most extensive, one covering the country lying between the towns of Casey and Westfield, Clark County, one southeast of Casey, Clark County, and a third in the vicinity of Robinson, Crawford County. The area between Casey and Westfield has been connected by pipe line to the Cincinnati, Hamilton and Dayton Railroad at Oil Field Station. From this place the oil is shipped by tank cars. At the end of the year 1905 fully 300 wells had been drilled within the field, and there was an established production of from 1,700 to 2,000 barrels a day.

PRODUCTION.

In the following table will be found the production of petroleum in Illinois during the year 1905, by months:

Production of crude petroleum in Illinois in 1905, by months.

Month.	Quantity.	Price per barrel at wells.	Month.	Quantity.	Price per barrel at wells.
	Barrels.			*Barrels.*	
June	6,521	$0.60	November	34,611	$0.66
July	17,306	.60	December	44,644	.70
August	23,827	.60	Total	181,084	*a*.643
September	26,586	.61			
October	27,589	.64			

a Average.

In the following table will be found the production in Illinois from 1889 to 1905, inclusive:

Production of petroleum in Illinois, 1889–1905.

	Barrels.		Barrels.
1889	1,460	1898	360
1890	900	1899	360
1891	675	1900	200
1892	521	1901	250
1893	400	1902	200
1894	300	1903	0
1895	200	1904	0
1896	250	1905	181,084
1897	500		

MID-CONTINENT FIELD.

Geology.—The petroleum of the Mid-Continent field is produced from the Pennsylvanian series of the Carboniferous system. The rocks of this series outcrop in the northeastern part of Indian Territory and pass through the southeastern corner of Kansas and extend to the northeast through Missouri. From their outcrop they dip to the west with an average of from 20 to 30 feet to the mile in northern Kansas and increase to double this in Indian Territory. At the base of these rocks is the Mississippian limestone with a thickness of from 300 to 400 feet. Directly above this are the Cherokee shales with a thickness of from 400 to 500 feet, capped by the Fort Scott limestone. Above the Fort Scott limestones are alternating shales and limestones extending to the surface.

All of the shales, especially the Cherokee, contain sandstone beds, some in the form of lenses, and others having a constant thickness extending over a considerable area. These sandstone beds form the reservoir from which the oil and gas is obtained. The most important sand so far discovered is near the base of the Cherokee shales. Two other horizons of pay exist, one near the top of the Cherokee shales, and the other above the Fort Scott limestone.

In the development of the Mid-Continent field a number of the test wells have been carried below the Cherokee shales and well into the Mississippi limestone. Some of these have produced favorable results, oil having been found at a horizon whose position is not well determined. It is probable that most of these pay streaks are from a sandstone within the Mississippian lime, and probably corresponding to the Keener sand in the Big lime of the Appalachian field. The production at Muscogee in Indian Territory probably comes from a sand at the base of the Mississippian limestone.

Oils of the Mid-Continent field.—The oils of the Mid-Continent field differ very much in quality. The specific gravity runs from 18° to 40° of the Baumé scale. They are dark in color, and carry some sulphur. The heavier oils come from the middle sand districts in Allen, Neosho, and Wilson counties and part of Montgomery County, in Kansas. In the shallow sand districts most of the oil runs from 29° to 33° Baumé scale, though from Chelsea to Goodys Bluff in the Cherokee Nation an oil is produced from shallow sand that has a gravity of from 33° to 37° Baumé.

In the deep-sand territory of Peru in Chautauqua County, Kans., along the eastern border of the Osage Nation in Oklahoma, and at Bartlesville and Ramona in the Cherokee district, Ind. T., the oil has a gravity of from 32° to 38° Baumé. The oil coming from the sand in or below the Mississippian limestone has been found lighter in specific gravity and containing a larger per cent of paraffin residue than those from the higher horizons. Its color is a dark green on reflected light and red by transmitted light.

Transportation.—Some of the oil of the Mid-Continent field is transported by railroad in tank cars. The quantity, however, handled in this way is small. Most of the oil is taken care of by the pipe lines of the Prairie Oil and Gas Company. This company buys oil at the tanks on the producing farms under regulations which differ somewhat from those followed in the eastern fields. They include the following conditions:

The oil is run subject to a division order showing what percentage belongs to the lessee and to the lessor.

The oil becomes the property of the Prairie Oil and Gas Company as soon as the same is received into its custody.

The oil is paid for, on any day selected by the owner within two months after the day the oil is run, at the market price offered by the Prairie Oil and Gas Company upon such day, and if no day is selected, at the price named on the first business day after the expiration of the two months.

The Prairie Oil and Gas Company deducts 3 per cent from all the oil received from wells on account of dirt and sediment, and in addition one-twentieth of 1 per cent for each degree of artificial heat above normal temperature to which the oil was subjected to render it merchantable.

The Whiting pipe line.—The completion of the pipe line from Humboldt, Kans., to Whiting, Ind., in June, 1905, marks another important step in the transportation of oil. This line, whose construction was commenced by the Prairie Oil and Gas Company in 1904, is for the purpose of transporting the oil from the great Mid-Continent field to the large refineries at Whiting, Ind. The line is 544 miles in length and consists of an 8-inch pipe, through which the oil is forced by fifteen pumping stations, distributed along the route. The capacity of the line is about 13,000 barrels per day, and with an additional pipe which will probably be laid in a short time it is hoped to relieve the congestion in Kansas and the Territories. With the completion of this line it is now possible to transport oil from the middle of the United States to the Atlantic Ocean by means of one continuous pipe line.

PRODUCTION OF THE MID-CONTINENT FIELD.

Up to the year 1901 the production of the Mid-Continent field was not an important factor in the total production of the United States. Since that year, however, the field has developed rapidly, until now it is a district which is engaging the attention of the producers to the exclusion of nearly all other fields.

The year 1904 showed the production of Kansas to have grown from 8,000 barrels to 14,000 barrels a day and an increase during the same time in Oklahoma from 1,000 barrels to over 11,000 barrels a day. In the year 1905 the percentage of increase in the production of Kansas was not so great, but in the two Territories the increase was by leaps and bounds, until the production for the full field in December, 1905, showed an average daily production of over 51,000 barrels. This production represented the oil that was taken from the ground, sold, and shipped. Besides this there was a large quantity of oil held in private tankage upon the field. The quantity of this stock so held was not known, but it was probably sufficient to increase the runs by many thousand barrels per day.

The year 1905 witnessed great efforts on the part of the Prairie Oil and Gas Company to extend its pipe-line system through Indian Territory and Oklahoma to the different oil-producing districts; also in the construction of large tank farms for the storage of vast quantities of petroleum.

In the following table is shown the production of the Mid-Continent field by months during the year 1905:

Production of crude petroleum in Kansas, Indian Territory, and Oklahoma in 1905, by months.

[Barrels.]

Month.	Pipe-line runs.	Shipments of crude by rail and consumption by refineries.	Total.
January	793,648	4,506	798,154
February	564,482	2,778	567,260
March	695,908	4,717	700,625
April	549,339	4,302	553,641
May	784,229	5,634	789,863
June	715,397	6,853	722,250
July	1,091,000	11,788	1,102,788
August	1,212,912	16,469	1,229,381
September	1,203,362	24,455	1,227,817
October	1,380,208	27,888	1,408,096
November	1,355,012	24,931	1,379,943
December	1,509,325	24,352	1,533,677
Total	11,854,822	158,673	12,013,495

In the following table is shown the total production of crude petroleum from the Mid-Continent field from 1889 to 1905, inclusive, with its percentage of the total production of the United States, and the quantity and percentage of decrease and increase each year:

Production of crude petroleum in the Mid-Continent field, 1889–1905.

[Barrels.]

Year.	Production.	Percentage of total production.	Increase.	Decrease.	Percentage.	
					Increase.	Decrease.
1889	500					
1890	1,200		700		140.00	
1891	1,430		230		19.17	
1892	5,080		3,650		255.24	
1893	18,010	0.04	12,930		254.53	
1894	40,130	0.08	22,120		122.82	
1895	44,467	0.08	4,337		10.81	
1896	113,741	0.19	69,274		155.79	
1897	81,723	0.14		32,018		28.15
1898	71,980	0.13		9,743		11.92
1899	69,700	0.12		2,280		3.17
1900	81,186	0.13	11,486		16.48	
1901	189,151	0.27	107,965		132.98	
1902	368,849	0.42	179,698		95.00	
1903	1,071,125	1.07	702,276		190.40	
1904	5,617,527	4.80	4,546,402		424.45	
1905	12,013,495	8.92	6,395,968		113.86	
Total	19,789,294					

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[Barrels.]

Year.	Production.	Percentage of total production.	Increase.	Decrease.	Percentage.	
					Increase.	Decrease.
1889	500					
1890	1,200		700		140.00	
1891	1,430		230		19.17	
1892	5,080		3,650		255.24	
1893	18,010	0.04	12,930		254.53	
1894	40,130	0.08	22,120		122.82	
1895	44,467	0.08	4,337		10.81	
1896	113,741	0.19	69,274		155.79	
1897	81,723	0.14		32,018		28.15
1898	71,980	0.13		9,743		11.92
1899	69,700	0.12		2,280		3.17
1900	81,186	0.13	11,486		16.48	
1901	189,151	0.27	107,965		132.98	
1902	368,849	0.42	179,698		95.00	
1903	1,071,125	1.07	702,276		190.40	
1904	5,617,527	4.80	4,546,402		424.45	
1905	12,013,495	8.92	6,395,968		113.86	
Total	19,789,294					

In the following table are shown the pipe-line runs, the shipments, and the stocks held at the end of each year from the Mid-Continent field from 1902 to 1905, inclusive:

Pipe-line runs, shipments, and stocks in Mid-Continent field, 1902–1905.

[Barrels.]

Year.	Total runs.	Total shipments.	Total stocks at close of year.
1902	[a] 368,849	....	126,268
1903	[a] 1,071,125	478,636	718,757
1904	5,603,037	1,068,329	5,207,219
1905	11,854,822	3,718,899	13,250,118

[a] Total production for the year.

PRICES.

In the following tables are given the prices obtained for petroleum from the Mid-Continent field during the year 1905, and also for 1903 and 1904.

On November 10, 1904, a change was made in the method of grading oil bought by the Prairie Oil and Gas Company; instead of grading all oil from a certain district at a given price each tank was graded according to its specific gravity. All of the oil above 32° Baumé scale received a certain price, and for each half degree below this a reduction of 5 cents was made down to 28° Baumé. Oil from 28° to 22° Baumé received a price 1 cent less than the 28° oil.

On March 8, 1905, the Prairie Oil and Gas Company stopped buying any oil under 30° Baumé, claiming that there was no market for it, but resumed the purchase of oil of this quality again in June, paying 25 cents a barrel for it.

Range of prices paid for petroleum by the Prairie Oil and Gas Company in Kansas and Indian Territory and Oklahoma in 1905.

[Per barrel of 42 gallons.]

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°.[a]
January 1	$0.80	$0.75	$0.70	$0.65	$0.60	$0.55	$0.50	$0.45	$0.40	$0.39
January 5	.77	.72	.67	.62	.57	.52	.47	.42	.37	.36
January 11	.72	.67	.62	.57	.52	.47	.42	.37	.32	.31
January 31	.70	.65	.60	.55	.50	.45	.40	.35	.30	.29
March 25	.68	.63	.58	.53	.48	......	......	......	......	......
April 12	.66	.61	.56	.51	.46	......	......	......	......	......
April 18	.61	.56	.51	.46	.41	......	......	......	......	......
April 25	.57	.52	.47	.42	.37	......	......	......	......	......
May 27	.53	.48	.43	.38	.33	......	......	......	......	......
June 17	.50	.45	.40	.35	.30	.25	......	......	......	......
September 12	.50	.46	.42	.38	.34	.30	......	......	......	......
September 28	.51	.48	.45	.42	.39	.35	......	......	......	......
October 20	.52	.49	.46	.43	.40	.35	......	......	......	......

[a] Heavy.

Range of prices paid for crude petroleum at wells in Kansas and Indian Territory in 1903, by districts.

Date.	Neodesha.	Chanute.	Humboldt.	Peru.	Independence.	Cherryvale.	Bartlesville.
January 1	$1.15	$0.95	....	$0.94	....	$0.95	$0.93
April 22	1.16	.96	....	.95	....	.96	.94
May 16	1.14	.94	....	.93	....	.94	.92
July 16	1.16	.96	....	.95	....	.96	.94
July 23	1.18	.98	....	.97	....	.98	.96
September 28	1.20	1.00	....	.99	....	1.00	.98
September 30	1.22	1.02	....	1.01	....	1.02	1.00
October 8	1.24	1.04	$0.60	1.03	$1.09	1.04	1.02
October 13	1.26	1.06	.60	1.05	1.11	1.06	1.04
October 17	1.28	1.08	.60	1.07	1.28	1.08	1.06
October 24	1.30	1.10	.60	1.09	1.30	1.10	1.08
October 28	1.32	1.12	.60	1.32	1.32	1.12	1.10
November 20	1.35	1.15	.60	1.35	1.35	1.15	1.13
December 2	1.37	1.17	.60	1.37	1.37	1.17	1.15
December 9	1.38	1.18	.60	1.38	1.38	1.18	1.16
December 29	1.36	1.16	.60	1.36	1.36	1.36	1.14

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

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

a In line. b On cars.

KANSAS.

The production of Kansas for the year 1905 can not, unfortunately, be separated from that of Oklahoma and Indian Territory. This is owing to the fact that the boundaries of these States pass through productive territories and across several of the pools, which causes a division of the production into correct quantity for each State to involve considerable clerical work. Owing to the pressure of other work, the Prairie Oil and Gas Company was not willing to undertake this detailed division at this time; hence the absence of the separate statement of the production of the States and Territories for the year 1905. It is hoped that in the future arrangements can be made so that the exact production for each can be given.

At the beginning of the year 1905 much dissatisfaction in the State of Kansas was caused by the drop in prices of crude oil per barrel as compared with the beginning of the year 1904. This resulted in much political agitation and in the forming of two associations of oil producers. The Kansas Oil Producers' Association was formed at Topeka on January 20, and the Chautauqua County Producers' Association at Sedan on April 21, 1905. The first of these associations devoted itself to the securing of legislative action governing the oil and gas business. This resulted in the passage of four bills by the Kansas legislature in February: The State refinery bill, which was later decided to be unconstitutional; the pipe-line common-carrier's bill; the antidiscrimination bill; and the maximum rate bill.

The Chautauqua County Producers' Association used its influence to curtail new developments and to increase the consumption of petroleum as fuel. The activity of this organization and the low price of oil greatly reduced the development of new territory. In 1905 only 1,518 new wells were drilled, as against 2,782 in 1904. The new wells made an initial daily production of 15,876 barrels, an average of 15.58 barrels per well.

WELL RECORD.

The well record of the Mid-Continental oil fields is published through the courtesy of the Independence Daily Reporter of Independence, Kans. These tables are compiled from the record of field operations kept by that paper and published monthly.

In the following table are shown the number of wells drilled in each county, the number that were dry, and also the number that produced gas, with the total initial production of the oil-producing wells and the average initial production per well:

Well record in Kansas in 1905, by districts.

District.	Wells.				Initial production.	
	Completed.	Dry.	Gas.	Productive.	Total.	Average per well.
					Barrels.	*Barrels.*
Allen	16	....	3	13	131	10.08
Chautauqua	284	30	19	235	6,497	27.65
Coffey	16	3	6	7	69	9.86
Elk	29	9	5	15	189	12.60
Franklin	63	4	4	55	773	14.05
Labette	1	1	....	....	....	....
Miami	392	16	35	341	2,546	7.47
Montgomery	322	54	117	151	3,426	22.69
Neosho	246	39	46	161	1,730	10.75
Wilson	87	16	30	41	515	12.56
Miscellaneous	62	25	37	....	....	....
Total	1,518	197	302	1,019	15,876	15.58

OKLAHOMA AND INDIAN TERRITORY.

Oklahoma.—The greater part of the oil so far developed within Oklahoma comes from the Osage Indian Reservation. The entire territory of the Osage Nation was leased to Edmund B. Foster and associates on April 8, 1896, for a term of ten years. Upon complaints made in 1898, this lease was canceled, but was reinstated in May, 1899. By assignment the lease on the land of the Osage Nation became the property of the Indian Territory Illuminating Oil Company in January of the year 1903. This company and parties to whom it has subleased large portions of the territory have carried on the development and had drilled by the 1st of January, 1906, 783 wells, of which 544 were oil producers and 41 were gas wells. The principal development has extended south through the eastern tier of lots and townships.

At the expiration of the original lease, on April 8, 1906, the lease on 680,000 acres was extended for a term of ten years, the royalty to be paid the Indians being increased from 10 to 12.5 per cent. The acreage upon which the lease was not extended reverted to the Osage tribe, to be held by them as a tribal possession for a term of twenty-five years.

Outside of the Osage Nation a considerable production has been developed in the vicinity of Cleveland, Pawnee County. The principal development consists of the Cleveland pool proper, which embraces the town site, together with an acreage which extends 3 miles north and south and is 1 mile in width. The pay sand is here found at a depth of 1,600 feet.

Besides the Cleveland pool proper, there are a number of smaller pools which produce from shallow sands. These are located principally to the south and east of Cleveland.

During the year 1905 a total of 100 barrels of crude petroleum was produced in Greer County. The oil is of a heavy lubricating character and was produced from four wells, which have an average depth of 180 feet. The crude sells for 25 cents a gallon at the well.

In Kay County is one well which produces a small quantity of lubricating oil of the highest grade.

Numerous wells have been sunk on large areas of land in Comanche County, and show strong gas pressure and oil of heavy lubricating character. None of the product has been marketed as yet.

Indian Territory.—The principal development in Indian Territory has been along the western edge of the Cherokee Nation, in the vicinity of Bartlesville and Ramona, where the oil is produced from the deep pay streak.

A district of shallow sand production has developed in the vicinity of Chelsea, and extends northward through Alluwe to Goodys Bluff.

In the Creek Nation considerable petroleum is found in the vicinity of Red Fork.

All leases taken in the Indian Territory must be approved by the Secretary of the Interior.

The following general conditions are included in the regulations made by the Secretary of the Interior in leasing the lands of the Cherokee and Creek nations in Indian Territory:

1. No person or corporation will be allowed to lease for the purpose of mining for oil or gas more than 4,800 acres of land in the aggregate. Explanation: The acreage of any lease held by a corporation will be debited against all stockholders of that corporation. If after reasonable and bona fide effort the lessee should be unsuccessful in finding and producing oil in paying quantities, he may, at any time, with the approval of the Secretary of the Interior, surrender and wholly terminate his lease, and said acreage will then be credited to him, giving him the privilege of again leasing other territory to the amount surrendered.

2. No lease will be approved for a greater term than fifteen years.

3. All original lessees will be required to furnish a bond with two or more sureties or with the bond of a bonding company regularly authorized to do business in the Territory, guaranteeing the payment of rents and royalties. These bonds shall be in amount equal to $500 for every 40-acre tract or fraction thereof, though no bond shall be for less than $1,000.

4. No lease, or any interest therein, or the use thereof, directly or indirectly, shall be sublet, by working or drilling contract or otherwise assigned or transferred, without the consent of the Secretary of the Interior.

5. All leases shall provide for the annual royalty payment in advance of not less than 15 cents per acre per annum for the first and second years, 30 cents per acre per annum for the third and fourth years, and 75 cents per acre per annum for the fifth year and each succeeding year thereafter.

6. All leases shall provide for the monthly payment of a royalty of at least 10 per cent of the value on the leased premises of all crude oil extracted.

The royalty upon each gas-producing well where the gas is utilized shall be $150 per year, payable at the end of the year. Failure to use a gas-producing well shall not work a forfeiture of the lease for oil purposes, but if the lessee desires to retain gas-producing privileges he or they shall pay a royalty of $50 per annum for each gas-producing well not utilized.

7. All lessees are required to drill at least one well on the premises covered by each lease within twelve months from the date of the approval of the bond. The lessee shall, however, have the privilege of delaying operations for a period of not exceeding five years from the date of the approval of the bond by paying the United States Indian agent, Union Agency, for the use and benefit of the lessor, in addition to the required annual advance royalty, the sum of $1 per acre per annum for each leased tract remaining undeveloped. The right is reserved, however, by the Secretary of the Interior to require the immediate development of any leased tract should he determine that the interest of the lessor demands such action.

8. No rents, royalties, or payments accruing under any lease which has been approved by the Secretary of the Interior shall be paid direct to the lessor, but all payments to be made under these leases shall be deposited with the United States Indian agent at Union Agency, or with such other person as may be designated by the Secretary of the Interior to receive the same.

9. Every lessee shall securely cap or plug each oil or gas well upon the land leased within three days after same is abandoned or not used, and every lessee failing to securely cap or plug his oil or gas well shall pay the United States Indian agent at the Union Agency for the use of the lessor the sum of $10 per day for each well during the time said well or wells remain not capped or plugged.

10. Every lessee is required to make showing of financial ability to properly develop the lease.

11. In the case of corporation lessees, a statement is required of the total number of shares, the capital stock actually issued, and the amount of cash paid into the treasury on each share sold, or, if in property, the kind and value of the same per share; how much cash the company has in its treasury and elsewhere, and from what source it was received; what property, exclusive of cash, is owned by the company; what is the total indebtedness of the company, and the nature of its obligations.

12. No lessee shall be allowed to drill oil or gas wells within 150 feet of the division line between the lands covered by their leases and adjoining leases whether the latter lands are leased or unleased.

Full and complete regulations for the sale and leasing of land in the Indian Territory will be furnished on application to the Department of the Interior.

PRODUCTION.

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, 1905:

Production of crude petroleum by the Indian Territory Illuminatin Oil Company and its sublessees from January 1, 1903, to December 31, 1905.

[Barrels of 42 gallons.]

Month.	1903.	1904.	1905.
January	7,147	10,338	223,888
February	5,697	10,133	213,059
March	3,907	9,428	198,184
April	6,749	11,998	188,883
May	3,255	12,888	241,753
June	6,211	12,143	215,191
July	5,166	22,626	359,297
August	4,386	49,907	331,908
September		82,156	314,052
October	8,109	115,118	383,479
November		118,206	370,157
December	6,278	197,538	381,627
Total	56,905	652,479	3,421,478

WELL RECORD.

In the following table is shown the number of wells drilled in the Osage Nation by the Indian Territory Illuminating Oil Company and its sublessees from 1903 to 1905, inclusive:

Oil and gas wells in the Osage Reservation, 1903–1905.

Total wells completed to—	Completed.	Productive.	Gas.	Dry.
January 1, 1903	30	17	2	11
December 31, 1904	361	243	21	97
June 10, 1905	544	355	34	155
December 31, 1905	783	544	41	198

In the following table is shown the number of wells drilled in Oklahoma and Indian Territory during the year 1905, with the total initial production and the average initial production per well:

Well record in Oklahoma and Indian Territory in 1905, by districts.

District.		Wells.				Initial production.	
		Completed.	Dry.	Gas.	Productive.	Total.	Average per well.
						Barrels.	*Barrels*
Indian Territory	Cherokee	1,480	139	44	1,297	39,118	30.16
	Creek	178	43	18	117	2,741	23.43
Oklahoma	Osage	507	111	24	372	34,124	91.73
	Other	360	56	17	287	21,395	74.55
Total		2,525	349	103	2,073	97,378	46.97

GULF FIELD.

Geology.—Most of the production of the Gulf field comes from that portion of the States of Louisiana and Texas known as the Coastal Plain. The surface geology of this area consists of beds of unconsolidated clays, sands, and marls, with some gravels in the upper portion, and an occasional thin layer of hard limestone. These are of recent geologic formation, probably pleistocene. Below this formation is a horizon whose geological area is not positively determined. Within this area are a number of strata, each of which probably covers only a limited area of dolomitic limestone. The top or cap is a hard, impervious rock and below this the rock is very porous, containing in some cases cavities of considerable size. In other localities there are beds of sand and sandstone, which form reservoirs for the oil and gas.

In these fields in which the reservoir stratum is of dolomitic lime, capped by hard lime, or very loose, porous, sandstone, capped by hard stratum, the production of the field is very prolific and the life of the well correspondingly short. From computations made from the quantity of production coming from the area of Spindle Top Pool, in connection with the thickness of the oil-bearing formation, a porosity of 33⅓ per cent has been computed for the reservoir district.

All of the surface formations have a very gradual slope to the southeast. The pools when found, however, prove to be small but very pronounced dome-shaped anticlines. The oil and gas have accumulated under these uplifts, and are surrounded on all sides by salt water. The process of tapping the oil reservoirs and of drawing off the oil and gas permits the salt water to rise and in time to drown out the wells completely. The great porosity of the reservoir rocks of this district makes the initial flow of the wells of the Coastal Plain area very large, with a life that is proportionately short.

Besides the Coastal Plain district of Texas and Louisiana, the northern portions of both States produce oil under entirely different conditions. Oil is here found in the sandstone of Cretaceous formations at a depth of from 300 to 400 feet from the surface. The production from this area per well is small, but more regular and lasting than that from the pools of the Coastal Plain area.

Oils of the Gulf field.—The oils of the Coastal Plain district are of the fuel variety, with a residue of asphaltum. They run in specific gravity from 18° to 28° of the Baumé scale, and produce the following percentage of commercial products:

Gasoline (66° test)	3.1
Kerosene (120° test)	14.1
Gas oil	55.0
Asphalt oil (residue)	25.1
Loss in waste	2.7

The oils from the northern portion of Texas are much lighter and produce a much larger proportion of illuminating oil.

PRODUCTION IN THE GULF FIELD.

During the last four years the Gulf oil field has produced 104,066,198 barrels of petroleum. By far the greatest portion of this enormous production has come from five separate pools, each of limited area, but of great richness. Each pool has represented an accumulation of a great many millions of barrels of petroleum in a reservoir from which it could flow with unlimited rapidity, the rate depending only upon the number of holes connecting the supply with the surface. Each pool, when discovered, has been developed and brought to its maximum production in a short period, after which its decline has been almost as rapid as its development.

Under these conditions it is evident that the maintenance of the enormous production of the Coastal Plain depends upon the discovery of new pools from year to year, and that without such new discoveries the production must fall within a short time to but a small percentage of its present total.

That the prospect for such new discoveries is good is undoubtedly true, as there are many places in which the surface indications are as favorable as were those where prolific pools have been found. There are also undoubtedly great accumulations of petroleum below the surface of the Coastal Plain from which no surface indications appear, and their discovery will be the result of wild-cat drilling, depending solely upon chance.

In the following table is given the production of the Gulf field for the year 1905, by months:

Production of crude petroleum in the Gulf field in 1905, by months.

Month.	Texas.	Louisiana.	Total.
January	1,855,898	876,096	2,731,994
February	1,616,523	778,852	2,395,375
March	2,228,879	979,010	3,207,889
April	2,397,373	768,686	3,166,059
May	3,479,126	623,283	4,102,409
June	3,868,521	764,392	4,632,913
July	3,494,169	661,064	4,155,233
August	2,767,886	731,820	3,499,706
September	1,914,522	632,351	2,546,873
October	1,652,666	747,636	2,400,302
November	1,492,326	661,682	2,154,008
December	1,394,369	685,544	2,079,913
Total	[a] 28,162,258	8,910,416	[a] 37,072,674

[a] Includes 26,069 barrels which were on hand and unsold at close of 1905.

In the following table is shown the total production and value of the crude petroleum produced in the Gulf field from 1902 to 1905, inclusive:

Production and value of crude petroleum in the Gulf field, 1902–1905.

[Barrels.]

Year.	Texas.		Louisiana.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1902	18,083,658	$3,998,097	548,617	$188,985	18,632,275	$4,187,082
1903	17,955,572	7,517,479	917,771	416,228	18,873,343	7,933,707
1904	22,241,413	8,156,220	2,958,958	1,073,594	25,200,371	9,229,814
1905	28,136,189	7,552,262	8,910,416	1,601,325	37,046,605	9,153,587

In the following table is shown the production of crude petroleum from the Gulf field from 1899 to 1905, with its percentage of the total of the United States, and the increase or decrease each year, and the percentage of increase or decrease:

Production of crude petroleum in the Gulf field, 1889–1905.

[Barrels.]

Year.	Production.	Percentage of total production.	Increase.	Decrease.	Percentage.	
					Increase.	Decrease.
1889	48					
1890	54		6		12.50	
1891	54					
1892	45			9		16.67
1893	50		5		11.11	
1894	60		10		20.00	
1895	50			10		16.67
1896	1,450		1,400		2,800.00	
1897	65,975	0.11	64,525		4,450.00	
1898	546,070	.99	480,095		727.69	
1899	669,013	1.17	122,943		22.51	
1900	836,039	1.31	167,026		24.97	
1901	4,393,658	6.33	3,557,619		425.53	
1902	18,632,275	20.99	14,238,617		324.07	
1903	18,873,343	18.79	241,068		1.29	
1904	25,200,371	21.52	6,327,028		33.52	
1905	37,046,605	27.50	11,846,234		47.01	

PRICES.

Average monthly prices of crude petroleum per barrel of 42 gallons at wells in the oil fields of Texas in the years 1904 and 1905 were as follows:

Average monthly prices of crude petroleum in Texas, 1904–1905.

Month.	Spindle Top.		Sour Lake.		Batson.		Saratoga.		Corsicana.	
	1904.	1905.	1904.	1905.	1904.	1905.	1904.	1905.	1904.	1905.
January	$0.34	$0.31 –$0.40	$0.37	$0.27 –$0.41	$0.25	$0.25 –$0.36	$0.20	$0.27 –$0.275	$1.162	$0.82⅜
February	.268	.31 – .365	.28	.227– .34	.20	.207– .29	.20	.2066	1.04	.82
March	.384	.30 – .355	.335	.27 – .33	.25	.24 – .28	.25	.2437	.94⅛	.82
April	.47	.33 – .39	.415	.29 – .37	.42	.26 – .31	.365	.26 – .265	.87½	.82
May	.48	.34 – .40	.465	.28 – .36	.46	.26 – .32	.38	.26	.84	.81⅞
June	.455	.32 – .37	.42	.23 – .37	.44	.245– .32	.38	.245	.80⅕	.81
July	.44	.307– .36	.42	.20 – .37	.42	.217– .31	.38	.2265	.72¼	.81
August	.417	.30 – .36	.405	.20 – .37	.40	.20 – .31	.375	.22 – .223	.763	.81
September	.434	.32 – .40	.39	.25 – .38	.36	.248– .32	.33	.238– .259	.85	.844
October	.41	.37 – .46	.38	.334– .40	.34	.31 – .35	.35	.29 – .32	.85	.898
November	.41	.45 – .50	.375	.36 – .44	.34	.34 – .40	.365	.34 – .35	.85	.897
December	.40	.45 – .52	.36	.36 – .46	.32	.34 – .41	.31	.35	.85	.89
Average	.389	.37045	.373	.3323	.34	.2715	.33	.279	.87–	.83+

Average monthly prices of crude petroleum in Texas, 1904–1905—Continued.

Month.	Powell.		Matagorda.		Henrietta.		Humble.	Dayton.	Jennings.	
	1904.	1905.	1904.	1905.	1904.	1905.	1905.	1905.	1904.	1905.
January	$0.462	$0.50		$0.35		$0.50	$0.16		$0.30	$0.15–$0.20
February	.40	.50		.35		.50	.15 – .16		.30	.15– .20
March	.40	.50		.35		.50	.15 – .1837		.40	.15– .22
April	.40	.50		.35	$0.475	.50	.15 – .20		.40–.50	.12– .22
May	.40	.50		.35	.475	.50	.15 – .17		.46–.50	.12– .22
June	.40	.50		.35	.475	.50	.145– .152		.50–.52	.12– .20
July	.40	.50		.35	.475	.45	.139– .16		.45–.57	.12– .20
August	43$\frac{1}{8}$	.50	$0.34	.50	.475	.45	.17 – .20		.40–.50	.16– .20
September	.50	.50	.34	.50	.475	.45	.21 – .285	$0.19	.30–.44	.18– .20
October	.50	.50	.34	.50	.475	.45	.25 – .34	.28–.34	.30–.46	.18– .23
November	.50	.50	.34	.50	.475	.45	.33 – .395	.34	.22–.35	.20– .25
December	.50	.50	.34	.50	.475	.45	.33 – .40	.34	.18–.33	.20– .27
Average	.43+	.50	.34	.359	.475	.475	.2263	.30275	.3589	.1788

WELL RECORD.

In the following table will be found the number of wells completed in 1905 and the number producing at the end of the year in each district of the Gulf field. Most of the well record information of the Gulf field is compiled from the statistics of field operations published monthly by the Oil Investor's Journal, of Beaumont, Tex.

Well record in Gulf field in 1905.

Field.	Wells completed in 1905.			Wells December 31, 1905.		Abandoned in 1905.
	Total.	Productive.	Dry.	Producing.	Not producing.	
Texas:						
Batson	107			260	12	231
Corsicana	68	50	18			41
Dayton	47			11	3	36
Henrietta	55	52	3			
Humble	449			116	87	246
Saratoga	43			66	10	22
Sour Lake	21			83	76	30
Spindle Top	21			80	2	64
Other Texas	15	7	8			
Louisiana:						
Jennings	27			42	54	33
Other Louisiana	8	4	4	5	7	
Total	861					

TEXAS.

The important historical features of Texas during the year 1905 have been the development of the Humble and Dayton pools.

Humble Pool.—This pool, situated in Harris County, on the Houston, East and West Texas Railroad, south of the San Jacinto River, was opened up by its first large productive well on the last day of the year 1904. During the year it was developed into one of the most prolific pools in Texas, having produced and shipped during the year a total of 15,594,310 barrels. The daily production increased rapidly from the first development of the pool until in March it had reached nearly 90,000 barrels a day. At this time there was a slight setback in the production owing to the entrance of salt water into a portion of the field. The development, however, continued, and the production had been increased by June to an average of over 90,000 barrels per day, and at one time up to as high as 130,000 barrels. From this time it gradually fell and closed the year with a daily production of less than 20,000 barrels.

During July the field was visited by a very disastrous fire, which destroyed over 2,000,000 barrels of oil.

Dayton Pool.—In the vicinity of Dayton, Liberty County, is an area having an elevation of from 20 to 30 feet above the surrounding plain. This is Dayton Hill, which has been known for a considerable period as a locality having favorable indications of oil and gas. During May of the year 1905 this area was successfully tested. No actual production was shipped, however, prior to September. The total production from this pool during the year amounted to 60,094 barrels.

The Dayton field produced two grades of oil, one 23½° gravity, Baumé scale, and one 17½°. The oil of higher gravity, of which the quantity was much less than of the heavier oil, brought as high as 37 cents per barrel, while the oil of lower gravity was worth from 28 to 32 cents per barrel.

Henrietta.—The Clay County oil field, at Henrietta, produced 101,661 barrels of crude petroleum during the year from 135 wells, 52 of which were completed in 1905. There was a small but gradual increase in the production each month of the year. Of the total production, 66,160 barrels were sold to refineries and 9,432 were used for fuel in the field, the remainder, 26,069 barrels, being placed in storage.

The wells are of an average depth of 275 feet and are operated by a center power connected by the shackle-rod method. The cost of drilling and equipping each well is small, and from 10 to 30 wells are connected to one central power and operated by one man. This method reduces the expense of operation, and makes it possible to produce oil at a profit.

Matagorda County.—The Big Hill oil field in Matagorda County shows a great falling off in production since the year 1904. Many wells have been closed down, though they are not entirely abandoned. During the year 1905 most of the crude petroleum piped from the field was consumed by the Cane Belt Branch of the Santa Fe Railroad, the remainder being consumed locally.

Brazoria County.—The Mound Oil Company, operating at Hoskin's Mound, produced a small quantity of crude petroleum during 1905. The oil is of 21° Baumé, and contains from one-third of 1 per cent to 1 per cent of sulphur. The depth of the well is 582 feet, and it is estimated to be capable of producing from 2,000 to 3,000 barrels per day.

South Bosque.—A small quantity of crude petroleum was shipped from the South Bosque field during 1905 to the refineries at Corsicana. Three wells have been drilled during the year and are producing from 2 to 5 barrels per day each.

Bexar County.—A small quantity of petroleum was produced from three wells in Bexar County, 6 miles east of San Antonio.

Jackson County.—There are six wells in Jackson County which produce a lubricating oil. Very little was produced and sold during the year 1905. For that sold a price of $4 per barrel was received at the well. The oil is thick, and of a reddish-black color. It is found in a porous sandstone of from 10 to 12 feet thick.

PRODUCTION.

In the following tables are given the production of crude petroleum in Texas in 1904 and 1905, by districts and months:

Production of crude petroleum in Texas, by districts and months.

1904.

[Barrels of 42 gallons.]

Month.	Spindle Top.	Sour Lake.	Batson.	Saratoga.	Corsicana.	Powell.	Henrietta.	Matagorda.	Total.
January	554,227	904,163	491,069	47,071	29,995	10,979	....	....	2,037,504
February	352,382	508,299	1,200,223	31,812	29,569	10,760	....	....	2,133,045
March	397,459	547,769	2,031,109	46,741	32,039	11,125	....	....	3,066,242
April	396,011	599,548	1,393,004	45,219	31,101	11,344	1,420	....	2,477,647
May	340,313	616,669	1,173,040	47,504	31,357	11,924	1,500	....	2,222,307
June	247,630	583,435	1,050,558	43,796	33,409	10,456	4,000	....	1,973,284
July	235,152	483,607	882,668	47,844	31,891	11,569	7,600	....	1,700,331
August	183,001	420,232	672,600	58,792	32,849	10,575	9,600	3,598	1,391,307
September	222,597	439,[illegible]30	575,151	104,132	31,986	10,296	8,500	21,003	1,413,595
October	152,322	419,880	500,384	128,601	30,883	9,627	9,055	16,370	1,267,122
November	202,356	452,295	487,048	67,285	29,184	10,020	12,395	42,804	1,303,457
December	150,392	466,470	447,883	70,442	30,055	10,584	11,385	68,161	1,255,372
Total	3,433,842	6,442,357	10,904,737	739,239	374,318	129,329	65,455	151,936	[a] 22,241,413

[a] Includes a small production in Bexar and McLennan counties.

1905.

Month.	Spindle Top.	Sour Lake.	Batson.	Saratoga	Corsicana.	Powell.
January	175,639	574,414	363,712	535,178	27,512	9,742
February	151,711	254,669	317,7[illegible]	350,398	23,068	10,132
March	170,247	341,0[illegible]	344,851	334,829	27,517	9,912
April	144,489	337,756	392,[illegible]75	230,521	25,995	11,774
May	139,907	332,459	371,974	303,288	27,198	10,686
June	132,584	248,258	337,659	297,912	26,780	10,068
July	125,661	224,659	340,492	193,907	26,816	10,544
August	130,725	217,706	301,751	234,183	26,734	10,908
September	114,397	191,841	269,229	187,177	26,258	10,265
October	113,836	197,619	255,541	163,500	25,820	10,647
November	110,400	209,515	250,426	159,146	24,375	12,380
December	143,184	232,233	228,537	134,989	23,481	15,808
Total	1,652,780	3,362,153	3,774,841	3,125,028	311,554	132,866

Month.	Humble.	Matagorda.	Henrietta.	Dayton.	Other.	Total.
January	152,653	11,807	5,216	....	....	1,855,898
February	495,847	6,566	6,313	....	....	1,616,523
March	989,432	4,526	6,516	....	....	2,228,879
April	1,241,490	4,626	7,822	....	....	2,397,373
May	2,278,835	6,090	8,664	....	....	3,479,126
June	2,798,162	7,360	9,713	....	....	3,868,521
July	2,560,679	2,746	8,640	....	....	3,494,169
August	1,834,662	1,225	9,967	....	....	2,767,886
September	1,095,895	575	9,178	9,682	....	1,914,522
October	857,753	450	8,752	18,723	....	1,652,666
November	699,750	300	10,562	15,447	....	1,492,326
December	589,152	200	10,318	16,442	....	1,394,369
Total	15,594,310	46,471	[a] 101,661	60,294	[b] 300	[a] 28,162,258

[a] Includes 26,069 barrels of oil which were on hand and unsold on December 31, 1905.
[b] Average.

The production of petroleum in Texas from 1895 to 1905, inclusive, has been as follows:

Production of crude petroleum in Texas, 1895–1905, by districts.

[Barrels.]

Year.	Corsicana.	Powell.	Beaumont.	Sourlake.	Saratoga.	Batson.
1895						
1896	1,450					
1897	65,975					
1898	544,620					
1899	668,483					
1900	829,560	6,479				
1901	763,424	37,121	3,593,113			
1902	571,059	46,812	17,420,949	44,838		
1903	401,817	100,143	8,600,905	8,848,159		4,518
1904	374,318	129,329	3,433,842	6,442,357	739,239	10,904,737
1905	311,554	132,866	1,652,780	3,362,153	3,125,028	3,774,841
Total	4,532,260	452,750	34,701,589			14,684,096

Year.	Dayton.	Matagorda.	Henrietta.	Humble.	Other.	Total.
1895					50	50
1896						1,450
1897						65,975
1898					1,450	546,070
1899					530	669,013
1900						836,039
1901						4,393,658
1902						18,083,658
1903					30	17,955,572
1904		151,936	65,455		200	22,241,413
1905	60,294	46,471	75,592	15,594,310	300	28,136,189
Total	60,294	198,407	141,047	15,594,310	2,560	92,929,087

The following table gives a statement of the production and value of crude petroleum at wells in Texas in 1904 and 1905, by districts:

Production and value of petroleum in Texas in 1904 and 1905, by districts.

[Barrels of 42 gallons.]

District.	1904.			1905.		
	Quantity.	Value.	Price per barrel.	Quantity.	Value.	Price per barrel.
Beaumont	3,433,842	$1,337,655	$0.389	1,652,780	$612,282	$0.370
Sourlake	6,442,357	2,401,911	.373	3,362,153	1,117,261	.332
Saratoga	739,239	244,660	.33	3,125,028	872,285	.281
Corsicana	374,318	325,657	.87−	311,554	258,590	.83
Powell	129,329	55,612	.43+	132,866	66,433	.50
Batson	10,904,737	3,707,671	.34	3,774,841	1,025,025	.272
Humble				15,594,310	3,528,768	.226
Dayton				60,294	18,255	.303
Henrietta	65,455	31,091	.475	75,592	35,906	.475
Matagorda	151,936	51,625	.34	46,471	16,677	.360
Other	200	338	1.69	300	780	2.60
Total	22,241,413	8,156,220	.367	28,136,189	7,552,262	.268

In the following table is given a list of the names of the companies which piped crude petroleum from the principal oil fields of Texas during the year 1905, together with the names of the districts in which the oil was produced:

Names of companies which piped crude petroleum from Texas in 1905, by districts.

Company.	District.					
J. M. Guffey Petroleum Company.	Batson		Humble	Saratoga	Sourlake	Spindletop.
The Texas Company	do	Dayton	do	do	do	
Security Oil Company	do	do	do		do	
Sun Pipe Line Company		do	do		do	Spindletop.
Higgins Oil and Fuel Company.			do		do	do
Rio Bravo Oil Company			do	Saratoga	do	
J. M. Abbott Oil Company.			do		do	
Heywood Oil Company						Spindletop.
Commercial Oil Company.			Humble			
Higgins-Paraffin Pipe Line Company.	Batson					
National Oil and Pipe Line Company.						Spindletop.
Sourlake Storage and Pipe Line Company.					Sourlake	

CORSICANA AND POWELL OIL DISTRICTS.

Production.—The following table shows the production of petroleum in the Corsicana and Powell light-oil districts:

Production of crude petroleum in the Corsicana and Powell oil districts, 1903–1905, by months.

[Barrels of 42 gallons.]

Month.	Corsicana (light oil).			Powell (heavy oil).		
	1903.	1904.	1905.	1903.	1904.	1905.
January	37,233	29,995	27,512	3,259	10,979	9,742
February	31,855	29,569	23,068	4,867	10,760	10,132
March	31,533	32,039	27,516	6,583	11,125	9,912
April	32,500	31,101	25,995	6,034	11,344	11,774
May	32,078	31,357	27,198	8,536	11,924	10,686
June	34,547	33,409	26,780	9,716	10,456	10,068
July	34,762	31,891	26,816	9,963	11,569	10,544
August	33,079	32,849	26,734	10,777	10,575	10,908
September	33,435	31,986	26,258	9,135	10,296	10,265
October	36,642	30,883	25,820	10,085	9,627	10,647
November	30,491	29,184	24,376	10,441	10,090	12,380
December	33,662	30,055	23,481	10,747	10,584	15,808
Total	401,817	374,318	311,554	100,143	129,329	132,866

Prices of Corsicana and Powell oil.—The following tables show the prices of Corsicana and Powell oil from 1903 to 1905, inclusive:

Fluctuations in prices of Texas Corsicana light oil, 1903–1905.

[Per barrel.]

Date.	Value.	Date.	Value.	Date.	Value.
1903.		1904.		1905.	
January 2	$1.06	January 1	$1.27	January 5	$0.82
April 22	1.08	January 12	1.17	May 27	.81
July 16	1.10	January 20	1.07	September 12	.83
July 23	1.12	February 12	1.02	September 16	.85
September 28	1.14	March 1	.99	September 19	.87
September 30	1.16	March 4	.96	September 28	.89
October 8	1.18	March 12	.93	October 20	.91
October 13	1.20	March 29	.90	November 11	.89
October 17	1.22	April 8	.87		
October 24	1.24	April 29	.84		
October 28	1.26	June 7	.81		
November 20	1.29	June 17	.78		
December 2	1.31	July 9	.73		
December 9	1.32	July 13	.70		
December 29	1.27	August 12	.80		
		September 1	.85		

Fluctuations in prices of Powell heavy oil, 1903–1905.

Date.	Value.	Date.	Value.	Date.	Value.
1903.		1904.		1905.	
January 2	$0.35	January 1	$0.55		$0.50
January 20	.50	January 12	.45		
May 2	.60	January 20	.40		
December 29	.55	August 12	.45		
		September 1	.50		

Average monthly prices of Corsicana and Powell oil at wells, 1903–1905.

[Per barrel.]

Month.	Corsicana.			Powell.		
	1903.	1904.	1905.	1903.	1904.	1905.
January	$1.06	$1.162	$0.82⅜	$0.413	$0.462	$0.50
February	1.06	1.04	.82	.50	.40	.50
March	1.06	.94⅛	.82	.50	.40	.50
April	1.066	.87½	.82	.50	.40	.50
May	1.08	.84	.81⅞	.596	.40	.50
June	1.08	.80⅕	.81	.60	.40	.50
July	1.097	.72¼	.81	.60	.40	.50
August	1.12	.763	.81	.60	.43⅛	.50
September	1.123	.85	.844	.60	.50	.50
October	1.206	.85	.898	.60	.50	.50
November	1.27	.85	.897	.60	.50	.50
December	1.311	.85	.89	.594	.50	.50
Average	1.14	.87−	.83+	.5716	.43+	.50

Well record in Corsicana and Powell districts.—The following tables show the well record in the Corsicana and Powell districts:

Well record in Corsicana and Powell oil districts in 1905, by months.

Month.	Wells.						Rigs.
	Completed.	Producing.	Dry.	Drilling.	Gas.	Abandoned.	
January	6	3	3	1	....	4	2
February	2	....	2	1	....	1	2
March	5	1	4	1	....	3	2
April	3	3	....	1	....	7	2
May	2	2	....	....	....	7	3
June	1	1	....	5	....	2	3
July	9	7	1	4	1	3	....
August	6	5	1	2	....	....	1
September	6	4	2	2	....	7	2
October	8	7	1	1	....	2	3
November	11	9	2	4	....	4	2
December	9	6	2	3	1	1	1
Total	68	48	18	[a] 2	2	41	[a] 2

[a] Average.

Well record in the Corsicana and Powell oil districts, 1898–1905.

Year.	Wells.							Rigs.	
	Completed.	Productive.	Dry.	Gas.	Abandoned.	Drilling.		Total.	Monthly average.
						Total.	Monthly average.		
1898	374	342	[a] 28	4	7	154	13	136	11
1899	268	169	[a] 90	9	79	154	13	95	8
1900	373	[b] 261	[a] 98	14	112	157	13	80	7
1901	68	[c] 47	16	5	27	51	4	47	4
1902	28	[d] 12	13	3	45	23	2	46	4
1903	100	70	23	7	51	65	5	35	3
1904	74	46	25	3	31	23	2	17	1
1905	68	48	18	2	41	25	2	23	2

[a] Includes 2 artesian wells.
[b] Includes 56 wells in what is known as the "Heavy oil district."
[c] Includes 10 wells in what is known as the "Heavy oil district."
[d] Includes 2 wells in heavy oil district.

SHIPMENTS.

Quantity of crude petroleum shipped by railroad in tank cars from the oil fields of Texas, at the stations named, during the year 1905, by months.

Month.	Beaumont.		Spindle Top.		Saratoga.		Sour Lake.	
	Cars.	Barrels.	Cars.	Barrels.	Cars.	Barrels.	Cars.	Barrels.
January	260	57,167	24	4,505	729	163,388	1,010	267,851
February	109	22,957	10	1,702	562	118,025	348	80,987
March	203	39,139	47	7,905	396	88,222	288	82,945
April	193	36,231	23	5,611	745	159,421	12	3,124
May	194	36,269	2	380	282	62,703	22	6,507
June	207	39,225	11	1,550	163	36,549	8	2,017
July	160	30,826	4	462	182	40,842	7	2,140
August	130	26,282	2	221	375	81,261	5	1,202
September	100	19,706	3	354	474	106,447	2	458
October	96	19,652	6	1,033	341	71,846	4	524
November	71	13,691	4	784	286	64,019	8	2,063
December	148	29,714	5	1,036	159	35,492	222	59,232
Total	1,871	370,859	141	25,543	4,694	1,028,215	1,936	509,050

Month.	Humble.		Big Hill.		Total.	
	Cars.	Barrels.	Cars.	Barrels.	Cars.	Barrels.
January	61	16,389	52	11,207	2,136	520,507
February	998	242,870	29	5,916	2,056	472,457
March	1,852	444,808	21	3,926	2,807	666,945
April	2,129	509,843	22	4,026	3,124	718,256
May	2,996	706,460	28	5,490	3,524	817,809
June	2,794	658,605	35	6,760	3,218	744,706
July	3,281	760,869	11	2,146	3,645	837,285
August	2,624	630,575	....	....	3,136	739,541
September	3,050	737,747	....	....	3,629	864,712
October	2,735	661,306	....	....	3,182	754,361
November	1,767	415,489	....	....	2,136	496,046
December	1,749	416,148	....	....	2,283	541,622
Total	26,036	6,201,109	198	39,471	34,876	8,174,247

NOTE.—These are the official figures furnished by the railroads which shipped the crude petroleum.

Quantity of crude petroleum shipped by railroad in tank cars from the Humble oil field of Texas, at the stations named, during the year 1905, by months.

Month.	Humble.		Houston.		Total.	
	Cars.	Barrels.	Cars.	Barrels.	Cars.	Barrels.
January	61	16,389	....	....	61	16,389
February	998	242,870	....	....	998	242,870
March	1,852	444,808	....	....	1,852	444,808
April	1,943	469,815	186	40,028	2,129	509,843
May	2,211	534,379	785	172,081	2,996	706,460
June	2,041	492,765	753	165,840	2,794	658,605
July	2,989	697,874	292	62,995	3,281	760,869
August	2,384	578,389	240	52,186	2,624	630,575
September	2,210	552,304	840	185,443	3,050	737,747
October	1,832	462,875	903	198,431	2,735	661,306
November	1,197	290,934	570	124,555	1,767	415,489
December	1,014	255,200	735	160,948	1,749	416,148
Total	20,732	5,038,602	5,304	1,162,507	26,036	6,201,109

NOTE.—These are the official figures furnished by the railroads which shipped the crude petroleum.

The following tables, furnished by the Bureau of Statistics, Department of Commerce and Labor, give the shipments of Texas crude petroleum and its derivatives from Port Arthur, Sabine Pass, and Galveston, and the ports to which this petroleum was shipped in 1904 and 1905, by months:

Shipments of Texas petroleum in 1904 and 1905 from Port Arthur, Sabine Pass, and Galveston, by months and by cargoes.

1904.

Month.	Port Arthur.		Sabine Pass.		Total.	
	Cargoes.	Quantity.	Cargoes.	Quantity.	Cargoes.	Quantity.
	Number.	*Barrels.*	*Number.*	*Barrels.*	*Number.*	*Barrels.*
January	26	597,421	6	175,727	32	773,148
February	21	554,493	10	224,827	31	779,320
March	27	704,896	7	168,429	34	873,325
April	23	585,911	8	161,549	31	747,460
May	32	720,666	16	403,123	48	1,123,789
June	20	509,141	13	264,956	33	774,097
July	24	630,571	14	292,314	38	922,885
August	25	636,119	19	468,033	44	1,104,152
September	22	519,528	9	211,131	31	730,659
October	17	547,828	13	233,191	30	781,019
November	20	438,221	10	214,344	30	652,565
December	24	513,940	10	255,100	34	769,040
Total	281	6,958,735	135	3,072,724	416	10,031,459
From Galveston					12	22,577
Total					428	10,054,036

1905.

Month.	Port Arthur.		Sabine Pass.		Galveston.		Total.	
	Cargoes.	Quantity.	Cargoes.	Quantity.	Cargoes.	Quantity.	Cargoes.	Quantity.
	Number.	*Barrels.*	*Number.*	*Barrels.*	*Number.*	*Barrels.*	*Number.*	*Barrels.*
January	19	439,560	13	384,967			32	824,527
February	15	327,733	9	228,490			24	556,223
March	27	610,109	11	240,763			38	850,872
April	22	544,467	13	420,736			35	965,253
May	27	737,873	10	342,525	[a] 3	[a] 124	40	1,080,522
June	21	502,690	10	273,635	5	8,013	36	784,338
July	27	623,755	10	289,738	6	21,613	43	935,106
August	23	591,624	7	211,167	3	20,000	33	822,791
September	27	648,659	5	183,788	5	9,218	37	841,665
October	26	641,215	8	162,977	2	58	36	804,250
November	24	637,106	10	309,701	3	113	37	946,920
December	31	681,805	7	180,714	1	271	39	862,790
Total	289	6,986,596	113	3,229,251	28	59,410	430	10,275,257

[a] Includes one cargo of 121 barrels shipped from Texas City.

Shipments of Texas petroleum, by ports, in 1905, by months.

[Barrels of 42 gallons.]

Port.	January.	February.	March.	April.	May.	June.
New York	276,109	302,508	458,023	497,889	672,001	373,033
Philadelphia	240,286	115,965	113,669	171,361	109,710	166,143
New Orleans	126,348	92,995	149,322	106,352	118,421	41,833
Morgan City, La	3,595	3,500	7,529			8,000
Marcus Hook, Pa	23,810	23,810	23,810			123,810
Dover, England	67,572		59,345	67,244	72,856	34,077
Habana, Cuba					51,190	
Tampa, Fla	21,066			53,288		19,905
Beverly, Mass	31,248			40,298		
Baltimore, Md	34,493		22,000		17,000	17,524
Coatzacoalcos, Mexico		17,445	17,174			
Antwerp, Belgium				28,821		
Cette, France					4,785	
Nuevitas, Cuba					3	10
Queenstown, Ireland					34,435	
Veracruz, Mexico					121	
Bremen, Germany						2
Liverpool, England						1
Total	824,527	556,223	850,872	965,253	1,080,522	784,338

Port.	July.	August.	September.	October.	November.	December.	Total.
New York	451,890	475,457	389,312	370,723	653,459	346,262	5,266,666
Philadelphia	113,157	179,666	134,220	163,779	101,205	225,000	1,834,161
New Orleans	23,122	13,305	11,174	21,021	3,361	29,451	736,705
Morgan City, La						2,000	24,624
Marcus Hook, Pa	61,905	85,714	100,239	47,620	23,810	25,000	539,528
London, England						271	271
Dover, England	194,974			73,444	58,625	132,189	760,326
Habana, Cuba					60		51,250
Tampa, Fla	29,886	22,270	21,025	44,021		18,979	230,440
Beverly, Mass				53,317		31,003	155,866
Baltimore, Md						43,875	134,892
Coatzacoalcos, Mexico	25,000			30,017			89,636
Antwerp, Belgium			20,155				48,976
Cette, France			27,998				32,783
Nuevitas, Cuba	7		1,218	18	50		1,306
Queenstown, Ireland	22,059		22,796				79,290
Veracruz, Mexico							121
Bremen, Germany							2
Liverpool, England				250			250
Belair, La	8,500						8,500
Fort Morgan, Ala	4,600						4,600
Havre, France	6						6
Portland, England		40,022					40,022
La Roche Maurice, France		6,357				5,591	11,948
Bayonne, N. J			73,910		103,147		177,057
Belfast, Ireland			39,198				39,198
Tampico, Mexico			420		3		423
Gibara, Cuba				40			40
Mobile, Ala					3,200		3,200
Gretna, La						3,169	3,169
Total	935,106	822,791	841,665	804,250	946,920	862,790	10,275,257

Shipments of Texas petroleum of all grades from Port Arthur, Sabine Pass, and Galveston, 1902–1905, by months.

[Barrels of 42 gallons.]

Month.	1902.	1903.	1904.	1905.
January	144, 382	422, 709	773, 148	824, 527
February	95, 940	514, 001	779, 322	556, 223
March	120, 702	515, 058	895, 849	850, 872
April	290, 972	556, 722	747, 493	965, 253
May	201, 858	544, 117	1, 123, 789	1, 080, 522
June	191, 723	752, 524	774, 098	784, 338
July	451, 824	963, 468	922, 885	935, 106
August	493, 092	796, 081	1, 104, 152	822, 791
September	505, 674	726, 506	730, 661	841, 665
October	386, 346	674, 881	781, 028	804, 250
November	519, 084	782, 371	652, 567	946, 920
December	583, 899	751, 901	769, 044	862, 790
Total	3, 985, 496	8, 000, 339	10, 054, 036	10, 275, 257

Exports to foreign countries of crude and refined petroleum from district of Galveston (Port Arthur and Sabine Pass) in 1905, by months.

[Gallons.]

Month.	Crude.		Naphtha.		Illuminating.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
January	1, 996, 889	$99, 844			52	$6
February	732, 713	36, 636				
March	721, 319	36, 066			2, 492, 504	162, 013
April	2, 824, 264	141, 213				
May	3, 601, 491	180, 075	536	$54	3, 298, 345	208, 820
June	1, 431, 654	71, 580			30	7
July	3, 791, 931	189, 598			5, 404, 383	331, 018
August	1, 681, 026	84, 052			380, 786	33, 473
September	1, 647, 545	82, 406			1, 175, 926	72, 026
October	1, 263, 158	63, 181			3, 084, 641	188, 934
November	4, 620	220			2, 462, 061	150, 801
December	1, 411, 507	70, 575			3, 261, 545	205, 347
Total	21, 108, 117	1, 055, 446	536	54	21, 560, 273	1, 352, 445

Month.	Residuum.		Lubricating and paraffin.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
January	828, 786	$26, 837			2, 825, 727	$126, 687
February					732, 713	36, 636
March					3, 213, 823	198, 079
April	1, 066, 086	31, 982	144, 401	$20, 116	4, 034, 751	193, 311
May	5, 166	311	3, 306	462	6, 908, 844	389, 722
June					1, 431, 684	71, 587
July	926, 463	27, 574	250	35	10, 123, 027	548, 225
August			5, 062	708	2, 066, 874	118, 233
September	957, 436	28, 723	846, 913	110, 134	4, 627, 820	293, 289
October	10, 500	438			4, 358, 299	252, 553
November	200	15	110	40	2, 466, 991	151, 076
December	1, 070, 690	31, 866	11, 375	1, 593	5, 755, 117	309, 381
Total	4, 865, 327	147, 746	1, 011, 417	133, 088	48, 545, 670	2, 688, 779

LOUISIANA.

Jennings.—During the year 1905 there were shipped by pipe line from the Jennings field 8,891,416 barrels of crude petroleum, a daily average of 24,360 barrels. This amounted to over three times the total production for 1904. The rate of production was maintained during the full year, the December runs being 685,957 barrels, a little less than the average monthly run of the year.

Welsh.—During the year there were produced in the vicinity of Welsh, Calcasieu Parish, 16,200 barrels of crude petroleum, of which 10,000 barrels were sold and consumed. A high grade of oil is produced in this district.

Analysis of petroleum from Welsh, La.

[F. C. Thiele, Beaumont, Tex., analyst.]

Physical characteristics:	
Color	Olive green.
Odor	Pleasant.
Specific gravity	19.2 Baumé at 60° F.
Viscosity	36.8°.
Commercial product:	
Naphtha	1.05
Illuminating oil	30.07
Lubricating oils	65.38
Coke, gas, and loss	3.50
	100.00

Remarks: This oil is entirely free from sulphur.

Anse-la-Butte.—During the year Anse-la-Butte, in Lafayette Parish, produced 9,000 barrels. This district is given a column in the table of production and value for the first time this year. During the years 1903 and 1904 a total of 4,065 barrels of crude was produced from this district, which was included in the Jennings output. There are two companies operating in this district, the Heyward Brothers Oil Corporation and the Lake Oil Company. Five productive oil wells have been completed, and a pipe line has been built into the district to take care of the crude.

PRODUCTION, PRICES, AND SHIPMENTS OF LOUISIANA PETROLEUM.

Production of petroleum in Louisiana, 1902–1905, by months.

[Barrels.]

Month.	1902.	1903.	1904.	1905.
January		46,560	35,242	876,096
February		65,108	37,720	778,852
March		82,900	37,446	979,010
April		83,725	66,239	768,686
May	25,000	75,279	88,152	623,283
June	60,000	97,137	86,585	764,392
July	75,000	95,473	82,356	661,064
August	92,894	78,017	341,282	731,820
September	68,723	67,345	521,191	632,351
October	81,257	66,630	530,502	747,636
November	70,707	63,994	557,565	661,682
December	75,036	95,603	574,678	685,544
Total	548,617	917,771	2,958,958	8,910,416

In the following table is given a statement of production and value of crude petroleum in Louisiana, 1902 to 1905, by fields:

Production and value of petroleum in Louisiana, 1902–1905, by fields.

[Barrels.]

Year.	Jennings.		Welsh.		Anse-la-Butte.		Total.	
	Quantity.	Value.	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	2,923,066	1,049,144	35,892	24,450			2,958,958	1,073,594
1905	8,891,416	1,589,825	10,000	7,500	9,000	$4,000	8,910,416	1,601,325

Average monthly price of crude petroleum per barrel at wells in the Jennings oil field in 1904 and 1905.

Month.	1904.	1905.	Month.	1904.	1905.
January	$0.30	$0.15–$0.20	August	$0.40–$0.50	$0.16–$0.20
February	.30	.15– .20	September	.30– .44	.18– .20
March	.40	.15– .22	October	.30– .46	.18– .23
April	$0.40– .50	.12– .22	November	.22– .35	.20– .25
May	.46– .50	.12– .22	December	.18– .33	.20– .27
June	.50– .52	.12– .20	Average	.3589	.1788
July	.45– .57	.12– .20			

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 1905, by months:

Rail shipments of crude petroleum from Jennings, Mermentau, and Egan stations, Louisiana, during the year 1905, by months.

Month.	Jennings.		Mermentau.		Egan.		Total.	
	Cars.	Barrels.	Cars.	Barrels.	Cars.	Barrels.	Cars.	Barrels.
January	1,568	367,870	1,184	294,810	216	57,697	2,968	720,377
February	1,467	318,272	765	195,803	155	41,191	2,387	555,266
March	1,725	391,809	829	203,579	324	90,511	2,878	685,899
April	1,285	277,913	835	200,348	412	119,470	2,532	597,731
May	809	171,918	1,315	296,360	411	108,847	2,535	577,125
June	591	143,176	937	206,591	362	97,128	1,890	446,895
July	661	152,310	703	152,940	544	139,624	1,908	444,874
August	565	131,967	498	108,094	315	68,992	1,378	309,053
September	666	144,580	598	126,126	382	100,068	1,646	370,774
October	1,046	242,668	710	165,782	468	106,155	2,224	514,605
November	1,557	351,022	671	163,157	211	49,763	2,439	563,942
December	1,598	356,709	608	141,096	339	81,235	2,545	579,040
Total	13,538	3,050,214	9,653	2,254,686	4,139	1,060,681	27,330	6,365,581

NOTE.—These are the official figures, calculations being made on the basis of 310.8 pounds of crude petroleum to a barrel of 42 gallons.

CALIFORNIA OIL FIELD.

Geology.—The geological conditions of the California oil fields differ materially from all of the other great producing fields of the United States. The porous formations which in California form the reservoirs for oil are of sand rock. The beds are usually much thicker than those found in the older oil fields. They often consist of a number of porous beds, all of which are saturated with petroleum and collectively give a producing horizon of many hundred feet in thickness. In most cases they do not lie at or near a horizontal position but are tilted, often having dips amounting to 60° or 70°. All of the formations have been much folded and faulted so that no general conclusions can be reached—each separate field is a distinct geological problem by itself.

PRODUCTION OF OIL IN CALIFORNIA.

A considerable increase was added to the enormous oil production of California during the year 1905. This was accomplished by the maintained production in nearly all of the older fields and the addition of a decided increase from the counties of Fresno, Los Angeles, and Santa Barbara.

Fresno County.—The Coalinga district of Fresno County made a steady and rapid growth during 1905. At the end of the year there were 228 producing wells, an increase of 68 during the year. The production increased from 5,114,958 barrels in 1904 to 8,000,000 barrels in 1905. In the district there are five different pipe-line companies which collect the oil and deliver it to Ora station on the Southern Pacific Railroad. Besides this, the California Oil and Transportation Company has a pipe line from the field to Monterey Bay, a distance of 110 miles. The Pacific Coast Oil Company delivers oil from the field to Mendota station on the main line of the Southern Pacific, and also connects with the main pipe line from the Kern River field to Point Richmond on San Francisco Bay.

The oil-bearing stratum of the field is a dark-brown sand and gravel, from 27 to 138 feet in thickness. The wells vary in depth from 700 to 2,800 feet. The oil is a dark greenish-black in color. It runs in gravity from 13° to 32° Baumé scale, the bulk of it being from 22° to 25°.

Santa Barbara County.—The increased production of Santa Barbara County comes from the Santa Maria field. In the first two years of drilling in this field wells were bored to a depth of 1,500 to 1,700 feet. The production from this horizon was not great. Deeper drilling proved the existence of a second oil-bearing stratum at a depth of from 2,400 to 3,200 feet. From this horizon wells of tremendous capacity were procured. The Hartwell gusher, which was brought in during the last month of 1904 with an initial flow of 8,000 barrels per day, was good for 3,000 barrels a day at the end of 1905.

The oil from the Santa Maria field ranges in specific gravity from 22° to 35° Baumé, the greater portion being between 22° and 27°.

Los Angeles County.—The increased production of Los Angeles County comes from a new development to the west of the city of Los Angeles. This is probably an extension of the Los Angeles city field. In the new territory oil is produced from a depth of from 800 to 1,500 feet. The well produces from 100 to 300 barrels a day.

Kern County.—The Kern River district showed a falling off in its production during 1905 as compared with 1904. This was not caused by the exhaustion of the productive territory, but by the failure to drill new wells because of the low price of oil in the field. With an increase in price to a more profitable figure, the territory is capable of a decided development.

The oil from the Sunset district ranges in gravity from 11° to 15° of the Baumé scale. The heavy quality of the oil makes it undesirable for refining and inconvenience of handling prevents its use for fuel purposes. Prior to 1905 very little had gone into the market. The very qualities which make it undesirable for other uses give it value as a dressing for public roads. For this purpose a considerable quantity was consumed during 1905. The oil comes from a coarse brown sandstone or conglomerate from 30 to 90 feet in thickness. The depth of wells ranges from 750 to 1,000 feet. The pools lie in narrow belts, from 500 to 3,000 feet in width, and extend in a northwest and southeast direction.

In the following table will be found the production and value of crude petroleum in California for the years 1904 and 1905, by counties:

Production of crude petroleum in California in 1904 and 1905, by counties.

[Barrels.]

County.	1904.			1905.		
	Quantity.	Value.	Price per barrel.	Quantity.	Value.	Price per barrel.
Fresno	5,114,958	$1,520,847	$0.297	10,967,015	$2,657,009	$0.24
Kern	19,608,045	3,431,408	.175	14,487,967	2,694,563	.186
Los Angeles	2,102,892	1,238,732	.589	3,469,433	930,349	.268
Orange	1,473,335	1,147,139	.7786	1,429,688	673,383	.471
Santa Barbara	789,006	445,292	.564	2,684,837	1,015,620	.378
Ventura	517,770	465,180	.898	337,970	212,973	.63
San Mateo	1,500	3,000	2.00	50,563	17,949	.355
Santa Clara	41,928	13,836	.33			
Total	29,649,434	8,265,434	.279	33,427,473	8,201,846	.245

The following table shows the production of crude petroleum in California, by counties, from 1900 to 1905, inclusive:

Production of crude petroleum in California, 1900–1905, by counties.

[Barrels of 42 gallons.]

Year.	Fresno.	Kern.	Los Angeles.	Orange.	Santa Barbara.	Ventura.	Santa Clara.	San Mateo.	Total.
1900	532,000	892,500	1,730,263	372,200	153,750	418,000	771	....	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
1905	10,967,015	14,487,967	3,469,433	1,429,688	2,684,837	337,970	50,563		33,427,473

WELL RECORD.

In the following table will be found the number of wells drilled in the different counties of California during the year 1905, with the number producing in each county at the beginning and the end of the year:

Well record in California in 1905, by counties.

County.	Productive January 1, 1905.	Completed in 1905.			Abandoned in 1905.	Productive December 31, 1905.	Producing December 31, 1905.
		Total.	Productive.	Dry.			
Fresno	159	69	69	....	....	228	228
Kern	795	96	93	3	16	872	829
Los Angeles	854	24	23	1	219	658	446
Orange	143	9	9	....	2	150	150
Santa Barbara	249	45	44	1	8	285	193
Ventura	265	5	5	....	8	262	246
San Mateo	8	4	1	3	4	5	3
Santa Clara	3	....	....	....	....	3	3
Total	2,476	252	244	8	257	2,463	2,098

OTHER STATES.

WYOMING.

Of the different States from which petroleum is procured in small quantities, Wyoming probably has the most promising conditions for the development of oil pools of large extent. Indications of oil are found in a number of different parts of the State.

A high grade of lubricating oil is produced in Natrona County. The oil is hauled by wagons to Casper, where it is refined.

In Crook County, near Moorcroft, there is also a small production of a fine quality of lubricating oil.

In Fremont County wells have been drilled in three different localities, in all of which a production was obtained, but owing to lack of transportation facilities this oil has not been marketed. The quality of the oil is of the fuel variety, with an asphaltic base.

The most promising locality in the State is in Uinta County. In this locality oil springs have been known since the time of the earliest explorations. From recent geological investigations by Mr. A. C. Veatch, of the United States Geological Survey, these indications of oil are found to be along a fault line which cuts the oil-bearing horizon at a considerable distance below the surface. The oil-bearing stratum outcrops a number of miles to the east of the fault line and has been developed in the vicinity of Spring Valley. In the fall of 1900 the Union Pacific Railroad Company began a water well at Spring Valley, Wyo., and on October 14 struck a white sand containing a very high grade of oil at a depth between 424 and 463 feet. Oil was struck again in December, between 567 and 575 feet, and again the following May, between 1,147 and 1,159 feet.

The following statement of the geologic conditions in which this oil exists is taken from the preliminary report of Mr. A. C. Veatch, of the United States Geological Survey, published in the Contributions to Economic Geology for 1905:[a]

Geologic relations.—At Spring Valley in all wells except the one in sec. 10, T. 14 N., R. 118 W., which will be discussed later, oil is found in sandy layers in a black shale. Geologically, this black shale occurs in the basal portion of the Benton. Failure to obtain oil has been recorded in three types of wells: (1) Those not deep enough to reach the oil-bearing strata, such as the Nebergall and Baker wells (Pl. XII, *B*); (2) those which, because of irregularities of the sandy layers in the shales, fail to develop oil, although it is found in adjacent wells (examples of this type are the Consolidated Oil Company's wells in the southwest corner of sec. 23, T. 15 N., R. 118 W.); (3) those located on the outcrop of the shales, particularly those near the eastern edge, where the beds are less than 500 feet thick (such as the well of the Illuminating Oil Company in sec. 26 and the well on the west side of sec. 24, T. 15 N., R. 118 W).

In general, no oil is found along the outcrop of this bed, but the amount increases with the dip. This, together with the irregularity shown in the position of the oil-bearing sands in adjoining wells and the fact that no water has been found in the oil-bearing beds, suggests that this oil has been formed from the shale in which it is found, and that the oil-bearing sands represent local sandy layers more or less perfectly surrounded by shales in which the oil has accumulated. This is the case also in the Boulder and Florence fields, although at those localities the shales are geologically younger. Where water is absent from the oil-bearing beds oil tends to move down the dip, and so far as the continuity of the porous beds allows will collect in the troughs of the synclines. This is apparently the case in this field, and the position of the syncline and the depth of the oil-bearing shale at its lowest point thus becomes one of considerable economic importance. At Hilliard the lowest point in the shale bed is over 11,000 feet from the surface and the dip of the beds is such that a deep well would be extremely difficult to sink. Between Hilliard and the Aspen tunnel the syncline rises and these beds may be thoroughly prospected with a hole 2,500 to 3,000 feet deep. This is a good location, although the oil-spring fault to the west introduces a point of leakage and the deepening of the syncline to the south affords a lower point of accumulation. Because of the normal character of the syncline at this point, a well properly placed may be drilled entirely in nearly horizontal strata.

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[a] Veatch, A. C., Coal and oil in southern Uinta County, Wyo.: Bull. U. S. Geol. Survey No. 285, 1906, pp. 331-353.

Northward the synclinal trough deepens rapidly, and at the Lazeart mine the oil shale is perhaps 10,000 feet from the surface. At Round Mountain the strata are overturned and faulted, and the site is not favorable for an oil well. Between Round Mountain and the top of the Adaville beds, north of Little Muddy Creek, the synclinal trough rises. The rise is gradual, the syncline is normal, and the locality in these respects is the best in the region. However, the great depth of the oil-bearing shales—5,000 to 7,000 feet—is practically prohibitive. To the north the syncline sinks, and at the Oregon Short Line the lowest point of the oil-bearing beds is about 15,000 feet from the surface. Farther north the syncline rises, and in the long trough north of a point 10 to 15 miles north of Kemmerer the conditions are very favorable. The depth of the oil-bearing shale in the center of the syncline is such that wells could be readily sunk, and test holes here are likely to yield returns. This region is beyond that examined this year, but enough was learned regarding it to warrant the above suggestion. Moreover, oil springs are reported in this region, and it is hoped that they may be critically examined next year.

In general, in the region covered by this report the depth of the oil-bearing shales at the axis of the syncline is practically prohibitive, but the soft character of the strata suggests that the diminution of pore space, due to the pressure of the superincumbent beds, may be so great that the maximum accumulation of oil will be at some point on the limb of the syncline, between the axis and the outcrop. Indeed, though the oil-bearing shales underlie a much larger area, prospecting should be restricted to the region between the axis of the Lazeart syncline and the eroded edge of the bed on the west flank of the Meridian anticline (Pl. XI).

The well of the Pittsburg and Salt Lake Oil Company, in sec. 10, T. 14 N., R. 118 W., develops an entirely different horizon. It is so situated that after passing through the Wasatch beds it strikes the older rock below the oil-bearing Benton shale (Pl. XII, *A*). It develops two oil-bearing sand beds in a light-blue shale, which is probably Jurassic and of the same age as the shale exposed on Twin Creek west of Nugget. The oil is black and more in the nature of a lubricating oil than that from the upper horizon. Prospecting for these lower horizons may be well carried on near and just west of the Meridian anticline. If in these lower strata water is also absent, the greatest yield will be found down the dip. In attempting to develop the shales of the same age on Twin Creek test wells should be located west of the outcrop, and in such a position that 500 or 1,000 feet of red beds may be drilled through before reaching the shales.

Analysis of oil from well of Pittsburg-Salt Lake Oil Company, in sec. 22, T. 15 N., R. 118 W., 1 mile north of Spring Valley, Wyo.

[C. F. Mabery, Cleveland, Ohio, 1900, analyst.]

	Per cent.	Gravity, Baumé.	Nature of product.
Given off at—		°	
50°–150°	21.3	65	Gasoline.
150°–305°	39.7	44	Burning oil.
305°–350°	16.4	36	Gas oil.
350°–330°	15.4	37	Cracked oil (partially cracked).
Residue	7.2	....	

Specific gravity, 0.81, or 44° Baumé.

The oil begins to crack at 350°; of course this product is really gas oil. The distillates 305–350°, 350–330°, and the residue contain much paraffin. These oils become solid when cooled in tap water with paraffin, so the yield is large.

We refined some of the burning oil, not, however, with reference to flash nor complete absence of color. It refines very easily and gives a very fine grade of burning oil.

Of course the proportions of products will be somewhat different on a refining scale (1,000 barrels)—probably larger, rather than smaller, than is given on the small scale.

This petroleum is different from any of the numerous specimens that I have previously examined from the Wyoming territory.

A large amount of very light gasoline can be separated by strong cooling.

With respect to the large proportion of gasoline and of burning oil, also of paraffin, this petroleum is one of the most valuable that I have ever examined.

It is a nonsulphur oil; percentage of sulphur, 0.03.

Very little lubricating oil can be obtained, and that only light, 28–30°, as the oil begins to crack at 350° or less, and will not stand higher distillation for the manufacture of heavier oils.

The paraffin in this oil is 6.2 per cent of the weight of the crude oil—more than is usually found in American petroleum.

PRODUCTION.

In the following table is found the production of petroleum from Wyoming from 1894 to 1905, inclusive:

Production of petroleum in Wyoming, 1894–1905.

[Barrels.]

1894	2,369	1900	5,450
1895	3,455	1901	5,400
1896	2,878	1902	6,253
1897	3,650	1903	8,960
1898	5,475	1904	11,542
1899	5,560	1905	8,454

COLORADO.

The production of petroleum from Colorado during 1905 showed a reduction as compared with the previous year. The percentage of reduction was about equal in both the Boulder and the Florence fields.

PRODUCTION.

In the following table is given the production of crude petroleum from the Florence and Boulder fields, by months, from 1903 to 1905, inclusive:

Production of crude petroleum in the Florence oil field in 1903, and in the Florence and Boulder fields in 1904 and 1905, by months.

[Barrels.]

Month.	1903.	1904.			1905.		
	Florence.	Florence.	Boulder.	Total.	Florence.	Boulder.	Total.
January	34,860	38,929	2,524	41,453	36,063	950	37,013
February	33,859	38,621	1,684	40,305	31,721	961	32,682
March	37,258	46,202	1,493	47,695	33,338	1,280	34,618
April	36,990	40,135	2,001	42,136	32,629	1,600	34,229
May	39,676	40,148	1,009	41,157	32,122	640	32,762
June	37,532	46,145	1,381	47,526	29,358	1,100	30,458
July	38,271	42,963	1,434	44,397	27,691	730	28,421
August	37,066	43,868	1,142	45,010	29,188	943	30,131
September	36,097	41,820	1,260	43,080	29,583	405	29,988
October	35,939	40,974	1,266	42,240	28,268	946	29,214
November	38,015	24,452	1,293	25,745	27,075	565	27,640
December	41,640	39,339	1,680	41,019	28,700	382	29,082
Total	447,203	483,596	18,167	501,763	365,736	10,502	376,238

In the following table will be found the production and value of crude petroleum from the Boulder and Florence fields in Colorado from 1903 to 1905, inclusive:

Production and value of crude petroleum in Colorado, 1903–1905, by districts.

[Barrels.]

District.	1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Boulder	36,722	....	18,167	$20,034	10,502	$11,502
Florence	447,203	....	483,596	558,001	365,736	326,104
Total	483,925	$431,723	501,763	578,035	376,238	337,606

In the following table will be found a statement of the production of crude oil in Colorado from 1900 to 1905, inclusive:

Production of crude oil in Colorado, 1900–1905.

[Barrels.]

1900	317,385	1903	483,925
1901	460,520	1904	501,763
1902	396,901	1905	376,238

MISSOURI.

In Missouri oil has been found in Clay, Vernon, and Jackson counties. In Clay County three wells have a small production. Vernon County produces a lubricating oil with an asphaltum base. The oil of Jackson County is also of lubricating quality. It is very black in color and almost entirely free from grit.

Production of petroleum in Missouri, 1900–1905.

[Barrels.]

1900	[a] 1,602	1903	[a] 3,000
1901	[b] 2,335	1904	[a] 2,572
1902	[a] 757	1905	[a] 3,100

[a] Includes the production of Michigan.
[b] Includes the production of Michigan and Oklahoma Territory.

MICHIGAN.

At Port Huron, St. Clair County, are 12 wells which have been producing a small quantity of petroleum for several years. The oil is dark green in color and of 38° gravity. The wells produce two-thirds of a barrel a day from brown lime rock at a depth of 537 feet.

The following is given as an analysis of Port Huron petroleum:

Analysis of Port Huron, Mich., petroleum.

Gasoline	5.00	Tar	5.00
Naphtha	10.00	Coke	5.00
Illuminating oil	55.00		
Lubricating oil	20.00		100.00

PORTO RICO.

The following table shows the variety, quantity, and value of the petroleum products exported from the United States to Porto Rico in 1903, 1904, and 1905:

Exports of refined mineral oils from the United States to Porto Rico in the years 1903, 1904, and 1905.

[Gallons.]

Kind of oil.	1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Naphtha	3,463	$602	14,515	$2,073	49,493	$7,697
Illuminating	1,063,041	123,947	1,096,751	132,656	1,365,446	140,569
Lubricating	98,520	15,432	117,702	23,185	93,513	20,253
Total	1,165,024	139,981	1,228,968	157,914	1,508,452	168,519

HAWAIIAN ISLANDS.

In the following table are given the exports of petroleum products to the Hawaiian Islands from 1903 to 1905, inclusive:

Exports of crude and refined petroleum to Hawaii from the United States in the years 1903, 1904, and 1905.

[Gallons.]

Kind of oil.	1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Crude	21,858,588	$726,974	18,470,010	$640,957	31,904,340	$1,112,939
Naphtha	262,682	33,412	243,063	29,709	320,703	39,069
Illuminating	1,372,570	203,803	1,015,828	168,490	892,094	142,313
Lubricating and paraffin	131,445	50,232	139,640	52,658	195,850	61,605
Total	23,625,285	1,014,421	19,868,541	891,814	33,312,987	1,355,926

PHILIPPINE ISLANDS.

The following table shows the exports of petroleum products to the Philippine Islands in the years 1903 to 1905, inclusive:

Exports of petroleum from the United States into the Philippine Islands in the years ending June 30, 1903–1905, by kinds of oil.

[Gallons.]

Kind of oil.	1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Naphtha	29,000	$5,715	50,210	$9,995	105,000	$16,384
Illuminating oil	2,803,101	265,624	3,294,020	385,171	7,358,810	750,817
Lubricating oil	57,006	8,309	102,721	23,717	161,734	31,799
Total	2,889,107	279,648	3,446,951	418,883	7,625,544	799,000

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 1905, by customs districts and by countries:

Imports of mineral oil into the United States in 1905, by customs districts and by countries.

[Gallons.]

	Free of duty.[a]		Dutiable.	
	Quantity.	Value.	Quantity.	Value.
CUSTOMS DISTRICT.				
Aroostook	....	....	200	$28
Baltimore	948	$85	18,338	5,155
Bangor	38,024	2,609	95	21
Boston	603,579	33,418	....	....
Newport News	694,539	51,804	....	....
New York	272,639	21,420	40,365	5,736
Galveston	4,485,236	220,290	2,608,229	79,955
Mobile	637,250	36,019	....	....
New Orleans	3,686,111	176,240	....	....
Alaska	....	....	126	85

[a] Mostly dead or creosote oil.

Imports of mineral oil into the United States in 1905, etc.—Continued.

	Free of duty.		Dutiable.	
	Quantity.	Value.	Quantity.	Value.
CUSTOMS DISTRICT—continued.				
Puget Sound	119,700	$12,768	....	....
Buffalo Creek	12,000	600	....	....
Chicago	....	....	43	$4
Detroit	69,416	8,453	....	....
Huron	434,679	16,564	....	....
Minnesota	....	....	4,203	873
Total	11,054,121	580,270	2,671,599	91,857
COUNTRY.				
Belgium	....	....	46,998	2,936
Germany	1,541,579	60,190	32,732	5,697
Russia, Baltic Sea	....	....	14,362	644
Spain	100	5	....	....
United Kingdom	8,928,273	489,903	34,526	4,352
Nova Scotia, etc	69,583	4,989	245	39
Quebec, Ontario, etc	514,586	25,183	4,379	968
Mexico	....	....	432	166
Dutch East Indies	....	....	2,537,445	77,051
Hongkong	....	....	480	4
Total	11,054,121	580,270	2,671,599	91,857

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, 1905, as compared with the preceding year:

Exports of mineral oils from the United States in 1904 and 1905.

[Gallons.]

Port and kind.	1904.		1905.	
	Quantity.	Value.	Quantity.	Value.
CRUDE.				
Delaware	61,733,773	$3,633,207	71,012,602	$3,673,869
New York	768,659	78,696	109,754	9,420
Philadelphia	18,973,662	1,300,061	10,034,152	612,207
Galveston	14,498,551	728,568	21,108,117	1,055,446
Other districts	15,201,831	610,150	23,920,562	734,650
Total	111,176,476	6,350,682	126,185,187	6,085,592
NAPHTHA.				
Baltimore	1,083	222	3,100	540
Boston and Charlestown	....	....	2,006	275
Delaware	169,373	15,401	110,697	9,810
New York	9,067,783	1,020,841	9,463,119	956,237
Philadelphia	13,599,108	1,058,753	17,248,998	1,091,486
Galveston	....	....	536	54
Other districts	2,152,075	226,497	1,591,474	156,207
Total	24,989,422	2,321,714	28,419,930	2,214,609

Exports of mineral oils from the United States in 1904 and 1905—Continued.

Port and kind.	1904.		1905.	
	Quantity.	Value.	Quantity.	Value.
ILLUMINATING.				
Baltimore	37,009,495	$2,967,008	26,346,654	$2,111,779
Boston and Charlestown	321,941	41,598	502,637	58,216
Delaware	766,426	43,079	136,267	10,252
New York	431,402,015	36,410,854	496,113,191	34,278,624
Philadelphia	258,027,732	16,765,552	314,170,691	15,807,194
Galveston	18,214,462	1,054,096	21,560,273	1,352,445
Other districts	15,616,084	1,102,086	22,620,675	1,282,139
Total	761,358,155	58,384,273	881,450,388	54,900,649
LUBRICATING AND PARAFFIN.				
Baltimore	2,226,308	280,479	2,870,846	367,646
Boston and Charlestown	121,682	20,143	110,908	19,114
Delaware	24,459	3,458	....	....
New York	61,728,992	9,195,701	77,564,888	10,175,530
Philadelphia	23,316,008	2,479,423	29,343,447	3,011,787
Galveston	28,033	3,214	1,011,417	133,088
Other districts	2,248,641	410,964	2,828,699	605,218
Total	89,688,123	12,393,382	113,730,205	14,312,383
RESIDUUM.				
Boston and Charlestown	540,288	29,546	428,712	21,507
New York	9,403,044	322,853	15,500,729	472,918
Philadelphia	16,267,952	527,538	45,937,183	1,321,213
Galveston	7,525,140	240,878	4,865,327	147,746
Other districts	1,167,676	53,341	3,995,926	164,312
Total	34,904,100	1,174,156	70,727,877	2,127,696
Grand total	1,022,116,276	80,624,207	1,220,513,587	79,640,929

RECAPITULATION BY KINDS.

[Gallons.]

	1904.		1905.	
	Quantity.	Value.	Quantity.	Value.
Crude petroleum	111,176,476	$6,350,682	126,185,187	$6,085,592
Naphtha	24,989,422	2,321,714	28,419,930	2,214,609
Illuminating oil	761,358,155	58,384,273	881,450,388	54,900,649
Lubricating oil and paraffin	89,688,123	12,393,382	113,730,205	14,312,383
Residuum	34,904,100	1,174,156	70,727,877	2,127,696
Total	1,022,116,276	80,624,207	1,220,513,587	79,640,929

RECAPITULATION BY PORTS.

Baltimore	39,236,886	$3,247,709	29,220,600	$2,479,965
Boston and Charlestown	983,911	91,287	1,044,263	99,112
Delaware	62,694,031	3,695,145	71,259,566	3,693,931
New York	512,370,493	47,028,945	598,751,681	45,892,729
Philadelphia	330,178,462	22,131,327	416,734,471	21,843,887
Galveston	40,266,186	2,026,756	48,545,670	2,688,779
Other districts	36,386,307	2,403,038	54,957,336	2,942,526
Grand total	1,022,116,276	80,624,207	1,220,513,587	79,640,929

The following table exhibits the total production of crude petroleum from 1871 to 1905, 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 products exported from, the United States during each of the calendar years from 1871 to 1905, inclusive.

Year.	Production.		Exports.			
					Mineral, refined or manufactured.	
	Barrels of 42 gallons.	Gallons.	Mineral, crude (including all natural oils, without regard to gravity).		Naphtha, benzine, gasoline, etc.	
			Gallons.		*Gallons.*	
1871	5,205,234	218,619,828	11,278,589	$2,171,706	8,396,905	$895,910
1872	6,293,194	264,314,148	16,363,975	2,761,094	8,688,257	1,307,058
1873	9,893,786	415,539,012	19,643,740	2,665,171	10,250,497	1,266,962
1874	10,926,945	458,931,690	14,430,851	1,428,494	10,616,644	997,355
1875	8,787,514	369,075,588	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	30,349,897	1,274,695,674	45,011,154	3,373,302	16,969,839	1,304,041
1883	23,449,633	984,884,586	59,018,537	4,439,097	17,365,314	1,195,035
1884	24,218,438	1,017,174,396	79,679,395	6,102,810	13,676,421	1,132,528
1885	21,858,785	918,068,970	81,435,609	6,040,685	14,739,469	1,160,999
1886	28,064,841	1,178,723,322	76,346,480	5,068,409	14,474,951	1,264,736
1887	28,283,483	1,187,906,286	80,650,286	5,141,833	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	50,514,657	2,121,615,594	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*	60,960,361	2,560,335,162	110,923,620	6,121,836	12,349,319	1,059,542
1897	60,475,516	2,539,971,672	121,488,726	5,020,968	13,430,320	994,781
1898	55,364,233	2,325,297,786	114,915,082	4,764,111	17,026,626	1,053,231
1899	57,070,850	2,396,975,700	117,683,967	5,957,829	17,904,015	1,557,607
1900	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	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	117,080,960	4,917,400,320	111,176,476	6,350,682	24,989,422	2,321,714
1905	134,717,580	5,658,138,360	126,185,187	6,085,592	28,419,930	2,214,609

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.	Exports.				Exports.			
	Mineral, refined or manufactured.				Residuum (tar, pitch and all other, from which the light bodies have been distilled).		Total.	
	Illuminating.		Lubricating (heavy paraffin, etc.).					
	Gallons.		*Gallons.*		*Gallons.*		*Gallons.*	
1871	132,178,843	$33,493,351	240,228	$92,408	101,052	$10,450	152,195,617	$36,663,825
1872	118,259,832	29,456,453	438,425	180,462	568,218	56,618	144,318,707	33,761,685
1873	207,595,988	41,357,686	1,502,503	517,466	1,377,180	117,595	240,369,908	45,924,880
1874	206,562,977	30,168,747	993,068	269,886	2,504,628	177,794	235,108,168	33,042,276
1875	203,678,748	28,168,572	938,052	265,837	2,323,986	169,671	237,526,312	31,734,861
1876	220,831,608	44,089,066	1,157,929	370,431	2,863,896	239,461	263,449,455	49,545,219
1877	307,373,842	51,366,205	1,914,129	577,610	4,256,112	390,077	361,883,225	57,539,873
1878	306,212,506	36,855,798	2,525,545	698,182	3,126,816	220,835	349,346,253	41,022,007
1879	365,597,467	32,811,755	3,168,561	713,208	4,827,522	273,050	421,719,782	37,235,467
1880	286,131,557	29,047,908	5,607,009	1,141,825	3,177,630	198,983	346,779,443	34,505,645
1881	444,666,615	42,122,683	5,053,862	1,165,605	3,756,018	197,521	514,561,719	48,556,103
1882	428,424,581	37,635,981	8,821,536	2,034,487	4,265,352	275,263	503,492,462	44,623,074
1883	440,150,660	39,470,352	10,108,394	2,193,245	6,502,524	465,350	533,145,429	47,763,079
1884	433,851,275	39,450,794	11,985,219	2,443,385	5,303,298	327,599	544,495,608	49,457,116
1885	445,880,518	39,476,082	12,978,955	2,659,210	5,713,908	334,767	560,784,459	49,671,743
1886	485,120,680	39,012,922	13,948,367	2,689,464	1,993,824	109,673	591,884,302	48,145,204
1887	485,242,107	37,007,336	20,582,613	3,559,280	2,989,098	141,350	601,846,317	46,898,842
1888	455,045,784	37,236,111	24,510,437	4,215,449	1,870,596	116,009	572,457,975	48,105,703
1889	551,769,666	41,215,192	27,903,267	4,638,724	1,858,458	97,265	680,705,456	53,293,299
1890	550,873,438	39,826,086	32,090,537	4,766,850	1,830,612	91,905	693,829,848	52,270,953
1891	531,445,099	34,879,759	33,310,264	4,999,978	1,002,414	61,382	673,905,577	46,174,835
1892	589,418,185	31,826,545	34,026,855	5,130,643	403,032	38,220	744,638,463	42,729 157
1893*a*	642,239,816	31,719,404	32,432,857	4,738,892	541,044	41,661	804,221,230	42,142,058
1894*a*	730,368,626	30,676,217	40,190,577	5,449,000	211,008	14,704	908,252,314	41,499,806
1895*a*	714,859,144	34,706,844	43,418,942	5,867,477	137,508	13,063	884,502,082	46,660,082
1896*a*	716,455,565	48,630,920	50,525,530	6,556,775	204,960	14,330	890,458,994	62,383,403
1897	795,919,525	46,229,579	51,228,284	6,478,479	12,230,902	333,740	994,297,757	59,057,547
1898	761,152,107	38,542,082	63,968,341	7,385,054	29,418,454	806,570	986 480,610	52,551,048
1899	724,562,993	48,466,200	69,329,188	8,344,735	21,544,278	655,878	951,024,441	64,982,249
1900	739,163,464	54,692,872	71,211,353	9,933,548	19,749,996	845,337	986,856,474	74,493,707
1901	827,479,493	53,490,713	75,305,938	10,260,125	27,596,352	1,254,983	1,079,074,519	72,784,912
1902	778,800,978	49,079,055	82,200,503	10,872,154	38,315,760	922,152	1,064,233,601	68,597,143
1903	691,837,234	51,355,668	95,621,941	12,690,065	9,753,240	282,129	936,697,255	72,628,539
1904	761,358,155	58,384,273	89,688,123	12,393,382	34,904,100	1,174,156	1,022,116,276	80,624,207
1905	881,450,388	54,900,649	113,730,205	14,312,383	70,727,877	2,127,696	1,220,513,587	79,640,929

a Exports are for fiscal years from 1893 to 1896, inclusive.

PRICES.

In the following tables the prices per gallon of refined oils of 70° Abel test are given.

Weekly prices of refined petroleum in the United States in 1905, in bulk and cases at New York and in barrels at Philadelphia.

[Cents per gallon.]

Week ending—	Refined oil. New York. Bulk.	Refined oil. New York. Cases.	Refined oil. Philadelphia. Barrels.	Week ending—	Refined oil. New York. Bulk.	Refined oil. New York. Cases.	Refined oil. Philadelphia. Barrels.
January 7	4.60	10.35	7.45	July 1	4.00	9.75	6.85
January 14	4.50	10.25	7.35	July 8	4.00	9.75	6.85
January 21	4.50	10.25	7.35	July 15	4.00	9.75	6.85
January 28	4.50	10.25	7.35	July 22	4.00	9.75	6.85
February 4	4.35	10.10	7.20	July 29	4.00	9.75	6.85
February 11	4.35	10.10	7.20	August 5	4.00	9.75	6.85
February 18	4.35	10.10	7.20	August 12	4.00	9.75	6.85
February 25	4.35	10.10	7.20	August 19	4.00	9.75	6.85
March 4	4.35	10.10	7.20	August 26	4.00	9.75	6.85
March 11	4.35	10.10	7.20	September 2	4.00	9.75	6.85
March 18	4.35	10.10	7.20	September 9	4.00	9.75	6.85
March 25	4.25	10.00	7.10	September 16	4.35	10.00	7.20
April 1	4.25	10.00	7.10	September 23	4.60	10.35	7.45
April 8	4.25	10.00	7.10	September 30	4.70	10.35	7.55
April 15	4.15	9.90	7.00	October 7	4.70	10.35	7.55
April 22	4.15	9.90	7.00	October 14	4.70	10.35	7.55
April 29	4.05	9.80	6.80	October 21	4.80	10.45	7.65
May 6	4.05	9.80	6.80	October 28	4.80	10.45	7.65
May 13	4.05	9.80	6.80	November 4	4.80	10.45	7.65
May 20	4.05	9.80	6.80	November 11	4.80	10.45	7.65
May 27	4.00	9.75	6.85	November 18	4.70	10.35	7.55
June 3	4.00	9.75	6.85	November 25	4.70	10.35	7.55
June 10	4.00	9.75	6.85	December 2	4.70	10.35	7.55
June 17	4.00	9.75	6.85	December 9	4.70	10.35	7.55
June 24	4.00	9.75	6.85	December 16	4.70	10.35	7.55

Wholesale prices of refined petroleum at New York at the first of each month, 1901–1905.

[Cents per gallon.]

Month.	1901. Date.	1901. Per gallon. In barrels.	1901. Per gallon. In cases.	1902. Date.	1902. Per gallon. In barrels.	1902. Per gallon. In cases.	1903. Date.	1903. Per gallon. In barrels.	1903. Per gallon. In cases.	1904. Date.	1904. Per gallon. In barrels.	1904. Per gallon. In cases.	1905. Date.	1905. Per gallon. In barrels.	1905. Per gallon. In cases.
January	2	7.60	8.65	1	7.20	8.30	7	8.30	10.60	6	9.10	11.80	4	7.65	10.35
February	6	7.70	8.75	5	7.20	8.30	4	8.20	10.50	3	9.10	11.80	1	7.25	9.95
March	6	7.95	9.00	5	7.20	8.30	4	8.20	10.50	2	8.75	11.40	1	7.25	9.95
April	3	7.95	9.00	2	7.20	8.30	1	8.35	10.50	6	8.50	11.20	5	7.15	9.85
May	1	7.40	8.40	6	7.40	8.50	6	8.35	10.50	4	8.15	10.85	3	6.95	9.65
June	5	6.90	7.90	4	7.40	8.50	3	8.55	10.50	1	8.15	10.85	7	6.90	9.60
July	3	6.90	7.90	2	7.40	8.50	1	8.55	10.50	6	7.95	10.65	5	6.90	9.60
August	7	7.50	8.50	6	7.20	8.50	5	8.55	10.50	3	7.70	10.40	2	6.90	9.60
September	4	7.50	8.50	3	7.20	8.50	3	8.55	10.50	7	7.85	10.55	6	6.90	9.60
October	2	7.65	8.75	1	7.20	8.50	7	8.80	11.50	5	7.95	10.65	4	7.60	10.30
November	6	7.65	8.75	5	7.45	8.75	4	9.20	11.90	2	7.95	10.65	1	7.70	10.40
December	4	7.65	8.75	3	7.90	9.20	2	9.50	12.20	7	7.95	10.65	6	7.60	10.30

Monthly average prices per gallon of oil exported from the United States in bulk, 1902–1905.

[Cents per gallon.]

Month.	1902.		1903.		1904.		1905.	
	Mineral, crude.	Refined, illuminating.	Mineral, crude.	Refined, illuminating.	Mineral, crude.	Refined, illuminating.	Mineral, crude.	Refined, illuminating.
January	4.5	6.2	5.4	7.4	6.4	8.1	5.3	6.6
February	4.1	6.3	3.9	7.1	6.1	8.7	5.4	6.2
March	4.5	6.0	6.0	7.0	5.9	8.3	5.3	6.8
April	4.0	6.3	4.8	7.2	6.3	7.5	4.5	7.0
May	4.5	6.5	5.4	7.4	5.7	7.8	4.6	5.9
June	4.8	6.0	5.6	6.9	5.8	7.8	4.9	5.9
July	3.9	6.3	5.4	7.1	5.9	7.1	4.8	5.9
August	4.3	6.1	5.7	7.0	5.4	7.5	4.1	6.1
September	4.3	5.8	4.5	7.3	5.0	7.9	4.7	5.8
October	5.0	6.2	5.7	8.0	5.6	7.7	4.8	6.2
November	4.4	6.6	6.1	7.9	5.2	7.1	4.5	6.5
December	3.9	7.3	5.5	8.6	5.8	6.9	5.1	6.4

Prices of American refined petroleum at Antwerp, Bremen, London, and Liverpool in 1904 and 1905.

	Antwerp (francs per 100 kilograms).		Bremen (marks per 50 kilograms).		London (pence per imperial gallon).		Liverpool (pence per imperial gallon).	
	1904.	1905.	1904.	1905.	1904.	1905.	1904.	1905.
January 1 to 15	22	19	6.35	6.35	7⅝–7¾	5½	7¾	6¼
January 15 to 31	22	19 –18½	6.35	6.35	7¾	5½–5⅜	7¾	6¼–6
February 1 to 14	22 –21½	18½	6.35	6.35	7¾	5⅜	7¾	6
February 14 to 29	21½–21	18½	6.35	6.35	7¾–7⅝	5⅜–5⅛	7¾	6
March 1 to 15	21 –20½	18½	6.35	6.35	7½–7⅛	5⅛	7¾–7¼	6
March 15 to 31	20½–20¼	18½–18¼	6.35	6.35	7⅛	5⅛	7¼	6
April 1 to 15	20¼–20	18¼–17¾	6.35	6.35	7⅛	5⅛	7¼	6 –5¾
April 15 to 30	20 –19¾	17¾–17½	6.35	6.35	7⅛–6⅝	5⅛	7¼	5¾
May 1 to 15	19¾	17½	6.35	6.35	6⅝	5⅛	7¼	5¾
May 15 to 31	19¾–19½	17½	6.35	6.35	6⅝–6⅜	5⅛	7¼–7	5¾
June 1 to 15	19½–19¼	17½	6.35	6.35	6 –5⅞	5⅛–5¼	7	5¾
June 15 to 30	19¼–19	17½	6.35	6.35	5⅞	5¼–5½	7	5¾–6
July 1 to 15	19 –18¾	17½	6.35	6.35	5⅞–5⅜	5½–5⅞	7	6– 5⅞
July 15 to 31	18¾	17½	6.35	6.35	5⅜–5½	5⅞–5¾	7– 6¾	5⅞–6
August 1 to 15	18¾	17½	6.35	6.35	5½	5¾–5⅝	6¾–6½	6
August 15 to 31	18¾	17½	6.35	6.35	5½	5⅝–5¾	6½	6
September 1 to 15	18¾–19	17½–18	6.35	6.35	5½–5¾	5⅝–5¾	6½	6
September 15 to 30	19 –19½	18 –19	6.35	6.35	5¾	5⅝–6⅞	6½	6
October 1 to 15	19½	19	6.35	6.35	5¾	5⅞–7	6½	6 –6¾
October 15 to 31	19½	19 –19½	6.35	6.35	5¾	6¾–6⅞	6½	6¾–6⅞
November 1 to 15	19½	19½	6.35	6.35	5¾–5⅝	6¾–7⅛	6½	6⅞–7¼
November 15 to 30	19½	19½	6.35	6.35	5⅝–5½	7⅛–7⅝	6½	7¼–8
December 1 to 15	19½	19½	6.35	6.35	5½	7⅝–6⅞	6½	8
December 15 to 31	19½–19	19½	6.35	6.35	5½	6⅞–6⅝	6½–6¼	8 –7⅞

100 kilograms=220.46 pounds.
277 cubic inches=1 imperial gallon=1.199 United States gallons.
231 cubic inches=1 United States gallon=0.834 imperial gallon.

1 franc=19.3 cents.
1 penny=2.027 cents.
1 mark=23.8 cents.

FOREIGN MARKETS.

In the following table is given a statement showing the foreign markets for our oil in the four fiscal years ending June 30, 1905:

Exports of petroleum in its various forms from the United States for the fiscal years 1902–1905, by countries.

[Gallons.]

Country and kind.	Year ending June 30— 1902.	1903.	1904.	1905.
CRUDE.				
Europe:				
France	89,733,032	82,192,041	66,212,481	47,015,325
Germany	6,848,989	6,338,191	3,990,063	5,669,934
Netherlands	....	....	1,266,406	774,085
Spain	10,132,815	11,095,516	8,066,482	11,822,756
United Kingdom	7,531,278	17,769,325	12,021,692	14,075,577
Other Europe	69,584	8,166	100	529
Total	114,315,698	117,403,239	91,557,224	79,358,206
North America:				
Mexico	10,844,913	9,859,154	10,938,441	14,036,517
Cuba	6,126,778	5,119,813	6,212,648	7,440,234
Dominion of Canada	....	....	5,862,148	22,220,665
Other North America	76,276	2,505,014	3,580	3,073
Total	17,047,967	17,483,981	23,016,790	43,700,489
South America	....	4,950	....	315
All other countries	2,173,135	....	2,906	....
Total crude	133,536,800	134,892,170	114,576,920	123,059,010
REFINED.				
Naphtha.				
Europe:				
France	4,381,896	5,550,675	7,147,327	8,980,020
Germany	7,852,195	1,866,357	....	3,258,042
Sweden	....	....	284,302	268,354
United Kingdom	8,259,392	2,376,877	5,942,545	11,806,289
Other Europe	728,505	295,713	6,822	2,393,251
Total	21,221,988	10,089,622	13,380,996	26,705,956
North America	1,269,189	1,642,869	2,198,312	1,645,855
West Indies	12,250	23,231	34,601	32,042
South America	171,438	292,066	298,769	502,955
Asia and Oceania	781,505	913,336	794,264	1,572,965
Africa	42,109	178,104	203,179	356,882
Total	2,276,491	3,049,606	3,529,125	4,110,699
Total naphtha	23,498,479	13,139,228	16,910,121	30,816,655
Illuminating.				
Europe:				
Belgium	43,231,583	44,141,816	38,569,610	39,526,415
Denmark	16,889,651	17,566,033	22,162,981	15,550,986
France	4,379,541	5,326,633	3,843,527	9,875,589
Germany	133,241,233	111,336,427	113,069,001	126,577,304
Italy	21,362,433	24,175,999	12,736,187	23,048,026

Exports of petroleum in its various forms from the United States, etc.—Continued.

Country and kind.	Year ending June 30— 1902.	1903.	1904.	1905.
REFINED—continued.				
Illuminating—Continued.				
Europe—Continued.				
Netherlands	120,984,836	116,817,141	111,328,359	110,037,453
Sweden and Norway	31,209,568	24,914,630	28,588,783	25,447,181
United Kingdom	211,228,093	149,281,493	165,248,727	174,057,928
Portugal	3,791,534	3,069,654	1,466,082	4,482,064
Other Europe	2,963,594	2,858,717	1,417,570	1,336,875
Total	589,282,066	499,488,543	498,430,827	529,939,821
North America:				
British North America	13,911,744	18,485,915	20,085,691	13,767,128
Central America	857,580	1,057,131	1,331,845	1,462,787
Mexico	371,421	342,000	409,266	461,266
West Indies—				
British	2,511,564	2,891,930	2,488,025	2,538,784
Other	3,125,750	2,723,404	2,912,099	3,728,017
Other North America	57,993	622,370	683,418	709,500
Total	20,836,052	26,122,750	27,910,344	22,667,482
South America:				
Argentina	9,682,775	12,107,291	12,216,938	15,818,832
Brazil	21,306,338	20,116,287	19,403,726	21,389,827
Chile	4,805,671	4,679,976	5,756,672	5,945,330
Uruguay	3,546,710	3,027,675	3,185,700	2,918,600
Venezuela	1,179,410	825,059	1,263,622	1,259,776
Other South America	2,809,956	3,026,178	3,772,257	3,391,885
Total	43,330,860	43,782,466	45,598,915	50,724,250
Asia:				
Chinese Empire	56,702,129	19,321,930	40,614,179	89,368,014
Hongkong	17,990,990	16,971,990	22,308,570	18,660,090
East Indies—				
British	10,364,540	10,130,090	9,667,103	24,853,070
Dutch	15,025,710	9,210,520	10,924,890	9,798,770
Other East Indies	....	1,327,720	3,872,450	1,242,000
Japan	59,598,671	32,547,509	46,007,530	26,824,694
Other Asia	1,398,200	849,415	918,574	4,194,710
Total	161,080,240	90,359,174	134,313,296	174,941,348
Oceania:				
British Australasia	15,131,216	22,953,588	18,212,764	21,633,821
Philippine Islands	1,971,100	2,803,101	3,294,020	7,358,810
Other Oceania	27,195	12,435	11,056	4,770
Total	17,129,461	25,769,124	21,517,840	28,997,401
British Africa	9,093,430	12,287,696	10,609,429	11,621,470
Other Africa	2,076,911	1,997,448	3,186,435	3,990,181
Total illuminating	842,829,070	699,807,201	741,567,086	822,881,953
Lubricating.				
Europe:				
Belgium	4,369,691	5,431,086	4,473,379	6,212,754
France	8,146,935	8,622,352	6,793,879	8,755,856
Germany	9,542,846	11,670,529	11,421,404	12,385,112
Italy	2,865,719	2,925,126	2,961,857	3,528,671

Exports of petroleum in its various forms from the United States, etc.—Continued.

Country and kind.	Year ending June 30—			
	1902.	1903.	1904.	1905.
REFINED—continued.				
Lubricating—Continued.				
Europe—Continued.				
Netherlands	5,822,073	6,161,447	5,424,718	6,569,410
United Kingdom	28,084,029	34,854,074	33,890,901	35,571,115
Other Europe	1,891,607	2,740,415	2,864,739	3,514,778
Total	60,722,900	72,405,029	67,830,877	76,537,696
North America	2,249,658	2,606,388	2,709,577	2,603,403
West Indies	531,515	616,721	830,913	786,106
South America	2,442,606	3,115,266	3,470,324	3,621,853
Asia and Oceania	9,344,628	12,569,338	11,864,610	11,798,775
Africa	744,304	2,005,515	2,103,829	2,009,363
Total	15,312,711	20,913,228	20,979,253	20,819,500
Total lubricating	76,035,611	93,318,257	88,810,130	97,357,196
Residuum (barrels).				
Europe	710,070	532,880	511,779	1,101,804
North America	10,916	9,654	24,131	59,768
All other countries	669	359	1,245	3,889
Total residuum	721,655	542,893	537,155	1,165,461

PRODUCTION OF FOREIGN COUNTRIES OF THE WESTERN HEMISPHERE.

CANADA.

In the following table is given the total production of crude petroleum in Canada from 1900 to 1905, inclusive, as reported by the Geological Survey of Canada:

PRODUCTION.

Production of crude petroleum in Canada, 1900–1905.

Year.	Quantity.	Value.	Average price per barrel.
	Barrels.		
1900	913,498	$1,479,867	$1.62
1901	756,679	1,225,820	1.62
1902	530,624	951,190	1.79¼
1903	486,637	1,048,974	2.15½
1904	552,575	984,310	1.78
1905	634,095	856,028	1.35

The following table shows the production of crude petroleum from the different districts of Canada from 1901 to 1905, inclusive, as reported by the Imperial Oil Company:

Production of crude petroleum in Canada, 1901–1905, by districts.

[Barrels of 35 imperial gallons, or about 42 standard gallons.]

District.	1901.	1902.	1903.	1904.	1905.
Petrolia	432,906	397,628	350,390	278,299	250,701
Oil Springs	76,059	60,747	56,405	75,530	78,125
Bothwell	52,873	50,141	48,880	47,654	47,959
Moore				36,971	93,815
Leamington			1,190	25,241	113,806
Dutton	10,588	8,867	21,483	14,217	20,976
Thamesville				5,027	2,463
Wheatley			1,995	4,490	1,750
Raleigh		2,462	1,161	3,274	
Pelee Island				1,023	
Blytheswood				669	
Comber				97	
Richardson Station (Chatham)					1,249
Total	572,416	519,845	481,504	492,492	610,844

The following table shows the imports from the United States into the different Provinces of Canada during the two fiscal years ending June 30, 1904, and 1905:

Quantity and value of petroleum imported from the United States into Canada in years ending June 30, 1904 and 1905, by districts.

[Gallons.[a]]

Dominion of Canada.	1904.		1905.	
	Quantity.	Value.	Quantity.	Value.
British Columbia:				
Crude	6,882	$480	2,380,430	$74,347
Naphtha	75,769	6,713	78,697	7,098
Illuminating oil	144,035	14,106	131,440	14,928
Lubricating oil	58,190	9,420	38,110	6,760
Total	284,876	30,719	2,628,677	103,133
Nova Scotia, New Brunswick, etc.:				
Crude				
Naphtha	5,536	746	6,555	889
Illuminating oil	4,091,147	351,766	3,415,633	287,687
Lubricating oil	163,522	32,774	145,945	30,776
Total	4,260,205	385,286	3,568,133	319,352
Quebec, Ontario, Manitoba, etc.:				
Crude	5,855,266	318,150	19,840,235	686,394
Naphtha	1,982,695	204,129	1,280,754	120,827
Illuminating oil	15,038,656	1,081,441	9,331,415	630,830
Lubricating oil	1,615,853	249,310	1,469,332	270,325
Total	24,492,470	1,853,030	31,921,736	1,708,376
Grand total	29,037,551	2,269,035	38,118,546	2,130,861
RECAPITULATION.				
Crude	5,862,148	318,630	22,220,665	760,741
Naphtha	2,064,000	211,588	1,366,006	128,814
Illuminating oil	19,273,838	1,447,313	12,878,488	933,445
Lubricating oil	1,837,565	291,504	1,653,387	307,861

[a] These are American gallons of 231 cubic inches; the Canadian gallon contains 277.27 cubic inches, and is nearly one-fifth greater than that of the United States.

Imports of petroleum and its products into Canada during the fiscal years ending June 30, 1902, 1903, and 1904.

[Imperial gallons.]

Oils.	1902.		1903.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Minerals:						
Coal and kerosene, distilled, purified, or refined, naphtha, and petroleum, not elsewhere specified	10,916,396	$878,087	14,479,176	$1,241,726	17,369,930	$1,526,989
Products of petroleum, not elsewhere specified	491,106	52,285	554,668	67,492	855,383	100,609
Crude petroleum, fuel and gas oils (other than naphtha, benzine, or gasoline) when imported by manufacturers (other than oil refiners) for use in their own factories for fuel purposes or for the manufacture of gas	591,328	40,568	2,143,888	136,092	4,318,569	275,515
Illuminating oils, composed wholly or in part of the products of petroleum, coal, shale, or lignite, costing more than 30 cents per gallon	7,256	2,541	4,126	1,725	10,076	3,646
Lubricating oils, composed wholly or in part of petroleum and costing less than 25 cents per gallon	1,213,919	133,726	1,617,454	196,336	1,967,157	245,864
Total	13,220,005	1,107,207	18,799,312	1,643,371	24,521,115	2,152,623

PRICES IN CANADA.

The average monthly prices per barrel for each year from 1901 to 1905, inclusive, are given in the following table. The production prior to 1895 was sold at prices established by the Petrolia Oil Exchange; now the producers make sales direct to the refiners.

Average monthly prices per barrel for crude oil at Petrolia, 1901–1905.

Month.	1901.	1902.	1903.	1904.	1905.
January	$1.60–$1.55	$1.61 –$1.68	$1.98–$2.02	$2.36	$1.42
February	1.55– 1.60	1.61 – 1.68	1.95– 2.02	2.34	1.37
March	1.60– 1.61	1.61 – 1.68	1.95– 2.02	2.24	1.37
April	1.59– 1.51	1.63½– 1.70½	1.96– 2.02	2.17	1.33
May	1.51– 1.41	1.66 – 1.73	1.99– 2.05	2.13	1.31
June	1.41	1.68½– 1.78	2.00– 2.07	1.84	1.30
July	1.41– 1.61	1.76 – 1.83	2.01– 2.10	1.59	1.30
August	1.61	1.76 – 1.83	2.03– 2.10	1.54	1.30
September	1.61– 1.66	1.76 – 1.83	2.03– 2.16	1.52	1.33
October	1.66	1.82 – 1.89½	2.16– 2.22	1.56	1.39
November	1.66	1.92 – 2.01½	2.26– 2.31	1.55	1.39
December	1.66– 1.61	1.96 – 2.04½	2.36– 2.44	1.53	1.38
The year	1.62	1.79¼	2.15½	1.78	1.35

NEWFOUNDLAND AND LABRADOR.

In the following table will be found the imports of crude petroleum and its products from the United States into Newfoundland and Labrador during the fiscal years from June 30, 1901, to June 30, 1905, inclusive:

Quantity and value of mineral oils imported from the United States into Newfoundland and Labrador, 1901–1905.

[Gallons.[a]]

Year ending June 30—	Oils, mineral refined, including residuum.	
	Quantity.	Value.
1901	[b] 788,805	$76,831
1902	[b] 810,325	76,611
1903	[b] 852,285	83,822
1904	[b] 908,443	100,330
1905	[b] 947,862	89,801

[a] American gallons. [b] Not including residuum.

MEXICO.

In the following table are given the imports of crude petroleum and its products from the United States into Mexico during the fiscal years June 30, 1901, to June 30, 1905, inclusive:

Quantity and value of mineral oils imported from the United States into Mexico, 1901–1905.

[Gallons.]

Year ending June 30—	Mineral.			
	Crude.		Refined, including residuum.	
	Quantity.	Value.	Quantity.	Value.
1901	8,356,258	$432,022	918,017	$168,773
1902	10,844,913	550,694	1,224,589	209,508
1903	9,859,154	559,332	1,153,015	218,272
1904	10,938,448	663,575	1,179,894	222,005
1905	14,036,517	786,613	....	224,061

CUBA.

In the following table are given the imports of crude petroleum and its products from the United States into Cuba during the fiscal years from June 30, 1901, to June 30, 1905, inclusive:

Quantity and value of mineral oils imported from the United States into Cuba, 1901–1905.

[Gallons.]

Year ending June 30—	Crude.		Refined.	
	Quantity.	Value.	Quantity.	Value.
1901	3,584,240	$239,802	1,853,410	$227,776
1902	6,126,778	307,215	1,690,219	216,616
1903	5,119,813	332,762	1,393,558	196,476
1904	6,212,614	475,621	1,606,620	249,469
1905	7,440,234	508,983	2,575,740	375,020

WEST INDIES.

The following table gives the quantity and value of illuminating oil imported from the United States into the West Indies:

Quantity and value of illuminating mineral oil imported from the United States into the West Indies, 1901–1905.

[Gallons.]

Year ending June 30—	British.		Dutch.		French.		Haiti.		Santo Domingo.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1901	2,468,793	$255,993	173,231	$17,236	437,303	$42,398	686,335	$64,687	578,875	$63,874
1902	2,511,564	245,026	151,160	14,589	389,717	34,937	640,607	57,264	572,225	56,136
1903	2,891,930	312,475	213,717	22,195	399,993	41,984	585,047	58,623	492,501	59,644
1904	2,488,025	332,866	179,339	22,534	363,138	45,219	743,391	81,937	622,562	81,035
1905	2,538,784	319,255	161,502	18,927	426,733	48,098	541,507	58,434	590,878	76,826

CENTRAL AMERICAN STATES.

The following table gives the quantity and value of illuminating oil and other products of petroleum imported from the United States into the Central American States:

Quantity and value of refined mineral oils imported from the United States into Central American States, 1901–1905.

[Gallons.]

Year ending June 30–	Costa Rica.		Guatemala.		Honduras.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1901	157,208	$19,847	164,497	$26,139	79,213	$11,612
1902	144,560	17,367	202,029	33,411	106,487	13,426
1903	179,046	24,764	184,766	32,182	113,841	16,302
1904	233,864	34,037	152,874	28,382	135,256	20,900
1905	72,766	12,002	246,614	37,619	147,794	21,019

Year ending June 30—	Nicaragua.		Salvador.		Panama.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1901	610,812	$62,559	72,878	$14,276	....	....
1902	375,447	40,273	80,819	14,498	....	....
1903	550,852	61,744	114,593	18,704	....	....
1904	477,310	61,520	158,113	25,624	322,749	$49,298
1905	429,996	52,598	139,389	22,648	796,572	109,282

The following tables give the quantity and value of refined petroleum imported from the United States into the countries of South America:

VENEZUELA.

Quantity and value of petroleum imported from the United States into Venezuela in years ending June 30, 1903, 1904, and 1905.

[Gallons.]

Kind of oil.	1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Illuminating	825,059	$86,507	1,263,622	$151,816	1,259,776	$138,333
Lubricating	19,568	5,313	26,657	8,315	27,264	6,957
Total	844,627	91,820	1,290,279	160,131	1,287,040	145,290

ARGENTINA.

Quantity and value of refined petroleum imported from the United States into Argentina in years ending June 30, 1903, 1904, and 1905.

[Gallons.]

Kind of oil.	1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Naphtha	105,096	$18,182	156,674	$30,892	318,711	$51,959
Illuminating oil	12,107,291	1,315,612	12,216,938	1,637,831	15,818,832	2,142,886
Lubricating oil	1,110,481	191,988	1,180,553	200,234	1,272,407	219,888
Total	13,322,868	1,525,782	13,554,165	1,868,957	17,409,950	2,414,733

BRAZIL.

Quantity and value of petroleum imported from the United States into Brazil in years ending June 30, 1903, 1904, and 1905.

[Gallons.]

Kind of oil.	1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Naphtha	19,997	$4,306	14,854	$3,196	11,665	$1,891
Illuminating oil	20,116,287	1,909,835	19,403,726	2,204,309	21,389,827	2,235,399
Lubricating oil	864,253	180,453	946,840	187,083	1,036,925	214,928
Total	21,000,537	2,094,594	20,365,420	2,394,588	22,438,417	2,452,218

COLOMBIA.

Quantity and value of petroleum imported from the United States into Colombia in years ending June 30, 1903, 1904, and 1905.

[Gallons.]

Kind of oil.	1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Naphtha	129,791	$16,244	79,496	$10,526	81,435	$10,443
Illuminating oil	853,867	94,238	1,291,627	153,514	858,535	100,320
Lubricating oil	49,127	11,024	46,817	12,808	39,183	9,545
Total	1,032,785	121,506	1,417,940	176,848	979,153	120,308

ECUADOR.

Quantity and value of petroleum imported from the United States into Ecuador in years ending June 30, 1903, 1904, and 1905.

[Gallons.]

Kind of oil.	1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Naphtha	9,600	$2,040	5,100	$1,183	2,920	$637
Illuminating oil	486,900	52,462	520,070	69,994	616,550	81,105
Lubricating oil	29,930	10,570	24,262	7,353	25,817	6,528
Total	526,430	65,072	549,432	78,530	645,287	88,270

PERU.

In the following table is given the production, with results obtained in commercial products from the Zorritos oil fields of Peru from 1901 to 1905:

Production of petroleum in Zorritos oil field of Peru, 1901–1905.

[Gallons.]

Year.	Crude petroleum.	Refined.	Lubricating oil.	Benzine and gasoline.
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
1905	1,584,242	[a] 300,000	....	29,570

[a] Kerosene.

The following table gives the quantity and value of refined petroleum imported from the United States into Peru from 1901 to 1905, inclusive:

Quantity and value of mineral oils imported from the United States into Peru, 1901–1905.

[Gallons.]

Year ending June 30—	Naphtha.		Oils, mineral, refined.			
			Illuminating.		Lubricating.	
1901	....	....	683,710	$76,101	145,719	$40,193
1902	....	....	434,540	43,773	75,962	20,059
1903	....	....	626,230	66,330	96,222	23,639
1904	1,010	$226	915,060	116,122	158,020	32,127
1905	1,305	277	646,025	83,363	193,022	41,200

FOREIGN COUNTRIES OF THE EASTERN HEMISPHERE.

RUSSIA.

During the year 1905 the great oil fields of Russia were visited with serious political riots and disturbances. These misfortunes have seriously curtailed the output of petroleum from that country.

PRODUCTION.

In the following table is given the total production from the Russian oil fields of Baku and Grosni, in poods, and also in barrels, for the years 1903 to 1905. These tables show a falling off in the year 1905 as compared with 1904, of 23,576,385 barrels.

Production of crude petroleum in Russia in 1903, 1904, and 1905, by fields.

Field.	1903.		1904.		1905.	
	Poods.	*Barrels.*	*Poods.*	*Barrels.*	*Poods.*	*Barrels.*
Baku	596,581,155	71,618,386	614,115,445	73,723,290	414,762,000	49,791,356
Grosni	33,094,000	3,972,870	40,095,331	4,813,365	43,057,052	5,168,914
Total	629,675,155	75,591,256	654,210,776	78,536,655	457,819,052	54,960,270

Total production of crude petroleum in Russia, 1900–1905.

[Barrels of 42 gallons.]

Year.	Baku.	Grosni.	Total.
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	4,813,365	78,536,655
1905	49,791,356	5,168,914	54,960,270

The total production of crude petroleum in the Apsheron Peninsula and the shipments of the chief petroleum products from Baku to all points from 1901 to 1905 have been as follows:

Total production of crude petroleum on the Apsheron Peninsula and shipments of petroleum products from Baku, 1901–1905.

[Barrels of 42 gallons.]

Year	Production.	Shipments from Baku.					
		Illuminating.	Lubricating.	Other products.	Residuum.	Crude oil.	Total.
1901	84,216,743	16,072,500	1,615,403	126,410	35,286,778	4,334,574	57,435,665
1902	76,414,045	15,026,000	1,750,367	298,657	38,049,555	4,090,036	59,214,615
1903	71,618,386	18,313,125	2,032,347	117,815	33,763,778	3,172,509	57,399,574
1904	73,723,290	19,205,250	1,896,455	159,355	33,622,111	2,249,340	57,132,511
1905	49,791,356	9,209,125	1,303,912	150,045	29,555,777	2,897,359	43,116,218

8.33 poods crude=1 United States barrel of 42 gallons.
8.00 poods illuminating oil=1 United States barrel of 42 gallons.
8.18 poods lubricating oil=1 United States barrel of 42 gallons.
9.00 poods residuum=1 United States barrel of 42 gallons.
7.50 poods naphtha=1 United States barrel of 42 gallons.
8.3775 poods other products=1 United States barrel of 42 gallons, estimated.
1 pood=36.112 pounds.
1 kopek=1.958 cents.
1 sagene=7 feet.

The following table shows the monthly production and the daily average production from the Baku oil field during the years 1903 to 1905, inclusive.

Production of crude petroleum in the Baku field, by months, in 1903, 1904, and 1905.

[Barrels of 42 gallons.]

Month.	Total production for years—			Average daily production.		
	1903.	1904.	1905.	1903.	1904.	1905.
January	6,177,851	5,468,472	5,414,165	199,286	176,394	174,650
February	5,402,135	5,483,778	5,102,041	192,933	189,095	182,216
March	5,947,271	6,154,627	5,978,391	191,847	198,536	192,851
April	5,794,632	6,283,786	5,666,266	193,154	209,459	188,876
May	7,217,257	6,755,678	4,705,882	232,815	217,925	151,802
June	7,066,007	6,583,587	5,558,223	235,533	212,373	185,274
July	4,419,500	6,647,152	5,690,276	142,565	214,424	183,557
August	6,161,136	6,597,651	3,877,551	197,042	212,779	125,082
September	5,862,085	6,495,798	259,547	195,403	216,526	8,652
October	5,990,384	7,054,915	2,208,883	193,206	227,598	71,254
November	5,950,944	7,327,532	2,941,176	198,365	244,251	98,039
December	5,637,409	2,852,876	2,388,955	181,852	92,027	77,063
Year	71,626,611	73,705,852	49,791,356	196,237	201,382	136,415

The division of the production among the districts of the Apsheron Peninsula or Baku field is as follows:

Production of the several districts of the Apsheron Peninsula, 1901–1905.

[Barrel of 42 gallons.]

Year.	Balakhani.	Sabunchi.	Romani.	Bibi-Eibat.	Binagadi.	Total.
1901	14,139,716	35,444,697	15,297,031	16,039,998	56,196	80,977,638
1902	12,185,354	32,071,908	16,800,000	15,298,200	58,583	76,414,045
1903	10,642,274	27,663,859	14,398,951	18,882,294	31,008	71,618,386
1904	9,848,380	26,029,292	16,063,505	21,745,618	36,495	73,723,290
1905	6,866,747	16,494,310	11,230,732	15,175,558	24,009	49,791,356

The production of crude petroleum from pumping (bucketing) and flowing wells for the last five years has been as follows:

Production of crude oil from pumping and flowing wells in Baku, 1901–1905.

[Barrels of 42 gallons.]

Year.	Pumping.	Flowing.	Year.	Pumping.	Flowing.
1901	68,806,438	12,171,200	1904	69,374,550	4,348,740
1902	65,035,894	11,378,151	1905	47,945,978	1,845,378
1903	65,194,016	6,424,370			

Production of crude petroleum from pumping wells in the Baku field, 1901–1905, by districts.

[Barrels of 42 gallons.]

Year.	Balakhani.	Sabunchi.	Romani.	Bibi-Eibat.	Binagadi.	Total.
1901	14,139,716	30,888,382	12,263,970	11,470,178	44,192	68,806,438
1902	12,185,354	30,853,901	12,172,389	9,765,667	58,583	65,035,894
1903	10,642,274	27,302,022	12,822,336	14,396,376	31,008	65,194,016
1904	9,848,380	25,384,514	15,043,217	19,061,944	36,495	69,374,550
1905	6,866,747	16,265,306	9,927,971	14,861,945	24,009	47,945,978

Production of crude petroleum from flowing wells in the Baku field, 1901–1905, by districts.

[Barrels of 42 gallons.]

Year.	Balakhani.	Sabunchi.	Romani.	Bibi-Eibat.	Binagadi.	Total.
1901	....	4,556,315	3,033,061	4,569,820	12,004	12,171,200
1902	....	1,218,007	4,627,611	5,532,533	....	11,378,151
1903	....	361,837	1,576,615	4,485,918	....	6,424,370
1904	....	644,778	1,020,288	2,683,674	....	4,348,740
1905	....	229,004	1,302,761	313,613	....	1,845,378

WELL RECORD.

In the table following is given a statement of the greatest number of wells drilling on the Apsheron Peninsula at any time during each of the years from 1901 to 1905, together with the total number of wells drilling deeper, and the total length, in sagenes, of all wells drilled:

Total number and condition of wells in Baku, 1901–1905.

Year.	Number of new wells sunk.	Total number of wells drilling.	Number of wells completed.	Total number of wells deepened.	Number of producing or active wells.	Total length of wells drilled.
						Sagenes. [a]
1901	282	1,153	358	311	2,042	75,665
1902	171	814	236	250	1,895	40,390
1903	233	862	198	278	1,877	49,355
1904	312	279	239	66	2,066	62,248
1905	140	141	154	....	880	35,663

[a] 1 sagene=7 feet.

Total number of wells in the Baku fields on December 31, 1904 and 1905.

Condition of wells.	Balakhani-Sabunchi.		Romani.		Bibi-Eibat.		Total.	
	1904.	1905.	1904.	1905.	1904.	1905.	1904.	1905.
Completed	....	98	....	23	....	33	239	154
Producing	1,190	607	193	110	172	151	1,555	[a] 880
Trial pumping	21	9	4	1	6	4	31	14
Drilling	134	63	62	27	83	51	279	141
Drilling deeper	27	41	17	27	22	23	66	91
Cleaning out and repairing	227	14	55	18	45	14	327	46
Standing idle	1,228	1,936	151	286	64	194	1,443	[b] 2,423
Rigs up, ready for drilling	40	33	10	7	10	13	60	53
New wells sunk	....	74	....	30	....	36	312	140
Length of wells drilled (sagenes)	....	16,755	....	6,925	....	11,983	62,248	35,663

[a] Includes 12 wells in Binagadi. [b] Includes 7 wells in Binagadi.

REFINERIES.

In the following table is given the results of the refineries of the Baku oil field during 1903, 1904, and 1905:

Operations of the Baku refineries, 1903–1905.

[Poods.[a]]

	1903.	1904.	1905.
I.—*Manufacture of illuminating oils.*			
DISTILLATION.			
Submitted to distillation:			
Crude	474,476,252	471,678,208	285,750,219
Other products	3,831,041	3,013,156	2,879,679
Total	478,307,293	474,691,364	288,629,898
Products received:			
Kerosene	142,825,855	145,434,298	67,637,730
Residuals	308,611,130	302,277,657	200,748,255
Other products	14,440,804	13,478,344	12,146,601
Loss	12,429,504	13,501,065	8,097,312
Fuel used	18,406,734	18,020,715	10,915,511
REFINING.			
Submitted to refining:			
Kerosene	142,361,093	145,836,212	64,904,153
Other distillates	363,053	408,880	340,283
Total	142,724,146	146,245,092	65,244,436
Refined products obtained:			
Kerosene	137,809,222	141,343,264	62,990,812
Other products	306,459	369,884	299,991
Loss in refining	4,608,465	4,531,944	1,953,633
Chemicals used:			
Acid	862,397	864,143	343,541
Soda	303,663	318,063	126,385
II.—*Manufacture of lubricating oils from distilled products.*			
DISTILLATES RECEIVED.			
Machine oil	14,242,155	14,316,347	8,794,903
Spindle oil	1,964,330	2,119,856	1,022,427
Cylinder oil	703,785	516,194	398,547
Goudron	7,559,017	7,687,298	5,540,617
Solar distillates	16,415,154	15,256,164	10,201,426
Residuals	15,028,561	11,655,176	7,030,740
Other distillates	183,131	193,614	94,381
Loss in distilling	3,997,012	3,133,918	1,726,400
Fuel used	7,240,089	7,150,105	5,586,173
REFINED PRODUCTS RECEIVED.			
Spindle oil	1,813,322	1,882,543	898,682
Machine oil	11,862,961	11,816,498	7,685,889
Cylinder oil	421,886	288,756	254,784
Loss in refining	1,808,551	1,648,245	1,000,120
Chemicals used:			
Acid	578,328	643,783	242,112
Soda	74,782	64,816	46,560

[a] 1 pood=36.112 pounds.

THE PETROLEUM TRADE OF NOVOROSSISK IN 1905.

The arrivals of petroleum products at Novorossisk from Baku and Grosni in 1905, compared to 1904, were as follows:

	1905.			1904.		
	From Baku.	From Grosni.	Total.	From Baku.	From Grosni.	Total.
Kerosene	6,474,831	846,492	7,321,323	21,182,871	1,400,594	22,583,465
Solar oil	117,769	....	117,769	850,638	....	850,638
Residuals	1,169,683	....	1,169,683	901,959	1,156,689	2,058,648
Ligroin	....	463,493	463,493	91,811	979,346	1,071,157
Kerosene distillate	....	....	....	....	492,109	492,109
Crude oil	....	2,253,640	2,253,640	....	4,577,489	4,577,489
Light benzine	....	265,788	265,788	....	17,718	17,718
Total	7,762,283	3,829,413	11,591,696	23,027,279	8,623,845	31,651,124

The shipments of petroleum products from Novorossisk in 1905, compared to 1904, to foreign and Russian ports were:

	1905.			1904.		
	Abroad.	To Russia.	Total.	Abroad.	To Russia.	Total.
Kerosene	8,255,059	724,140	8,979,199	20,732,643	1,043,834	21,776,477
Solar oil	380,424	....	380,424	885,448	....	885,408
Residuals	1,277,457	847,285	2,124,742	1,455,876	1,586,729	3,042,605
Ligroin	249,319	....	249,319	838,607	15	838,622
Kerosene distillate	375,860	....	375,860	451,675	....	461,675
Crude oil	....	2,468	2,468	....	3,262	3,262
Benzine distillate	....	340	340	55,118	796	55,914
Light benzine	162,430	1,784	164,214	....	5,061	5,061
Goodron	....	2,249	2,249	....	1,519	1,519
Total	10,700,549	1,578,266	12,278,815	24,419,327	2,641,216	27,060,543

The stocks of petroleum products at Novorossisk on January 1, 1906, compared to January 1, 1905, were:

	January 1—	
	1906.	1905.
Crude oil	108,000	72,730
Kerosene and kerosene distillate	594,880	3,394,014
Solar oil	146,000	350,685
Benzine and ligroin	298,900	286,795
Residuals	1,090,000	1,087,023
Other products	24,800	26,000
Total	2,262,580	5,217,247

STOCKS AT BATUM.

The following were the stocks held at Batum at the close of the year 1905, in poods and barrels:

Stocks at Batum, December 31, 1905.

	Poods.	Barrels.		Poods.	Barrels.
Kerosene	2,834,901	308,140	Lubricating oil	14,192	1,540
Distillate	18,804	2,040	Mazoot	207,213	20,721
Solar oil	430,993	46,850	Crude oil	5,597	650
Machine oil	33,035	14,460	Total	3,584,236	399,351
Machine distillate	19,642	2,790			
Cylinder oil	19,859	2,160			

PRICES.

Weekly prices of petroleum in Russia in the year 1905 at Baku.

[Kopecks per pood.]

	Refined.		Crude.	Residuals.
	For export.	For inland.		
January 2	17½		13¾	14 -14½
January 9			14 -14½	14½-15
January 6			14⅜	15
January 23	19 -19½		14½-15	15
January 30	18½		14½	15½
February 6		16	14 -14½	15
February 13		16	13¼	15
February 20	16 -17		13½	15½-15¾
February 27			13½	
March 6			13⅞	15½
March 13			14⅛	16
March 20			14½	15⅞-16
March 27		14	14⅝	16 -16½
April 3			15	17
April 10	14	14½	15⅜	16¾-17
April 17			15¼	17
April 24			15¼	16¾-17
May 1			15¾	17¾
May 8			17¼	17¾
May 15		17½	16⅜	17¾
May 22	15¾-16	18	17¼-17½	18¼
May 29	15¾-16	17¾	17¼-17½	18¼
June 5	18½	18½	18 -1 ½	19½
June 12	18	19½	20 -20½	20
June 19	20	19½	21 -21½	21½-22
June 26			21⅜	
July 3		20	21½	22½
July 10			20¾	22¾
July 17			21½	22½-22¾
July 24		19½-20	21¼	21½-22¾
July 31		19½-20	20½	21¼-22½
August 7			20⅝	23¼-23⅝
August 14			22 -22½	23¾-24
August 21		22⅛-23	23¼-23½	24⅞-25½
August 28	25		24½	25⅞
September 4				
September 11				
September 18				
September 25	45	45	38	40
October 2			35	35
October 9			35	35
October 16			31	
October 23	38		27½	34
October 30			27½	
November 7			27½	
November 14			27½	
November 21			27½	
November 28			20	
December 5			18½-1 ½	
December 12				32
December 19			18 -18½	
December 26				

AUSTRIA-HUNGARY.

PRODUCTION.

In the following table is given the production of petroleum in Galicia during the year 1905, by districts and months:

Production of crude petroleum in Galicia in 1905, by districts and months.

[Metric tons.]

District.	January.	February.	March.	April.	May.	June.
Boryslaw	45,965	47,410	50,315	54,205	48,410	42,977
Schodnica	4,952	4,846	5,551	5,748	5,502	5,138
Urycz	1,894	1,890	2,179	1,778	1,626	1,702
Mraznica	330	629	349	320	280	448
Other eastern districts	720	850	880	880	950	1,000
Potok	1,760	2,010	2,010	2,048	2,010	2,320
Rogi	3,192	2,663	2,680	2,144	2,203	1,887
Rowne	113	112	123	143	156	138
Tarnawa	2,385	2,562	1,561	1,924	2,316	2,034
Krosno	3,214	3,018	4,253	3,464	4,477	3,565
Other western districts	2,755	2,810	3,150	3,217	3,146	2,962
Total	67,280	68,800	73,051	75,871	71,076	64,171

District.	July.	August.	September.	October.	November.	December.	Total.
Boryslaw	41,457	41,687	41,749	43,447	47,125	41,809	546,556
Schodnica	5,050	4,739	4,914	4,570	4,526	4,666	60,202
Urycz	1,653	1,480	1,500	1,582	1,519	1,544	20,347
Mraznica	300	280	220	200	150	140	3,646
Other eastern districts	1,000	840	910	870	880	820	10,600
Potok	1,937	1,868	1,394	1,695	1,526	1,901	22,479
Rogi	1,905	1,698	1,738	1,624	1,305	1,195	24,234
Rowne	141	152	122	151	135	123	1,609
Tarnawa	1,984	2,575	2,720	4,047	4,354	4,494	32,956
Krosno	4,275	3,895	3,490	3,536	3,586	2,786	43,559
Other western districts	3,050	3,041	2,962	2,887	2,803	2,825	35,608
Total	62,752	62,255	61,719	64,609	67,909	62,303	801,796

The following are the equivalents in value, weight, and length:

1 crown=20.3 cents.

1 florin or gulden=40.2 cents.

1 metric ton=2,204.62 pounds.

1 metric ton=7.1905 barrels of crude petroleum of 42 gallons=2,204.62 pounds.

$\left.\begin{array}{l}\text{1 metric centner}\\ \text{1 quintal}\end{array}\right\}$ =100 kilos (220.462 pounds).

1 kilogram=2.20462 pounds.

1 gallon refined petroleum=6.6 pounds.

1 gallon crude petroleum=7.3 pounds.

1 quintal or 1 metric centner of refined petroleum=0.795317 barrel of 42 gallons.

1 quintal or 1 metric centner of crude petroleum=0.71905 barrel of 42 gallons.

1 kilometer=3,280.89 feet=0.6213 mile.

In the following table is given a statement of the production of crude petroleum in Galicia from 1900 to 1905, inclusive, as ascertained by the statistical bureau of the Galizischer Landes-Petroleum-Verein, Lemberg:

Production of crude petroleum in Galicia, 1900–1905.

Year.	Quantity.		Year.	Quantity.	
	Metric centners.	*Barrels of 42 gallons.*		*Metric centners.*	*Barrels of 42 gallons.*
1900	3,263,340	2,346,505	1903	7,279,710	5,234,475
1901	4,522,000	3,251,544	1904	8,271,167	5,947,383
1902	5,760,600	4,142,159	1905	8,017,964	5,765,317

In the following table are given production and stocks on hand at the beginning and at the close of the year 1905 for the different districts of the Galicia oil field:

Crude petroleum production and stocks in Galicia in 1905, by districts.

[Metric tons.]

Locality.	Stocks January 1, 1905.	Production in year 1905.	Shipments in year 1905.	Loss and fuel consumption at works in 1905.	Stocks December 31, 1905.
Boryslaw and Tustanowice	341,204	546,556	468,042	16,400	403,318
Schodnica	28,337	60,202	53,015	1,984	33,550
Urycz	21,695	20,347	18,582	1,333	22,126
Other localities in eastern Galicia	950	14,246	10,831	2,154	2,210
Potok	4,824	22,479	21,390	124	5,790
Rogi	11,106	24,234	20,737	342	14,261
Równe	171	1,609	1,467	14	299
Tarnawa and Wielopole	479	32,956	24,930	245	8,260
Krosno	4,379	43,559	33,920	218	13,800
Other localities in western Galicia	8,820	35,608	33,451	560	10,408
Total, 1905	421,965	801,796	686,365	23,374	514,022
Total, 1904	214,815	827,117	592,099	24,859	424,974

The data given in the following tables show the development of the Galician petroleum industry. Up to the year 1895, inclusive, the figures are taken from the statistical reports of the Austrian ministry of agriculture, and those since 1895, inclusive, from the reports of the Galician Petroleum Association.

Production of crude petroleum in Galicia, 1886–1905, by districts.

[Metric tons.]

Year.	Quantity.	District.
1886	42,540	Gorlice district (Kryg, Lipinki, Libusza, Siary, Sekowa, Kobylanka, Mencina, Wojtowa Harklowa); Bobrka; Lodyna, near Ustrzyki; Ropianka, near Dukla; Sloboda; Rungurska.
1887	47,817	The above districts, and Wietrzno, near Bobrka; Weglowka, near Krosno; Wankowa, and Ropienka, near Olszanica.
1888	64,882	Same, and Równe, near Dukla.
1889	71,659	Same.
1890	91,650	The above, and Strzelbice and Stary Sambor.
1891	87,717	The above, and Patok, near Krosno.
1892	89,871	The above, and Torogzowka, near Krosno; Brelikow, near Olszanica.
1893	96,331	Districts as in 1886.
1894	132,000	Districts as in 1886, and Schodnica.
1895	214,810	Districts as in 1886, chiefly Neu Sandez to Sanok and Lisko to Stryj.
1896	339,765	Chiefly the second named in above.
1897	309,626	Chiefly the second and Pasieczna.
1898	323,142	Do.

Production of crude petroleum in Galicia, 1886–1905, by districts—Continued.

Year.	Quantity.	District.
1899	316,384	Chiefly the second and Pasieczna.
1900	326,334	Chiefly the second and Pasieczna, and Boryslaw, Urycz, Bitkow.
1901	452,200	Do.
1902	576,060	Do.
1903	727,971	Chiefly Boryslaw and Schodnica.
1904	827,117	Chiefly Boryslaw.
1905	801,796	Do.

WELL RECORDS IN GALICIA.

Well records in Galicia, 1900–1904.

Year.	Shafts.			Drill holes.				Iron pipe line.	Oil tanks.	
	Total.[a]	In course of excavation.	Oil producing.	Total.[a]	In course of excavation.	Oil producing.			Iron.	Wood.
						Hand power.	Steam power.			
								Meters.		
1900	223	3	67	2,703	257	186	1,578	279,735	276	1,583
1901	187	5	25	2,808	303	171	1,704	337,289	346	1,615
1902	77	5	18	2,795	295	165	1,773	405,760	339	1,821
1903	64	....	17	2,859	293	128	1,691	433,656	369	1,692
1904.										
Krakow:										
Jaslo	27	1	2	1,409	63	96	802	254,913	189	559
Drohobycz	5	....	3	1,342	292	6	669	212,157	191	1,004
Stanislaw	....	....	....	171	6	21	119	29,193	13	185
Total, 1904	32	1	5	2,922	361	123	1,590	496,263	393	1,748

[a] Including idle wells.

ROUMANIA.

PRODUCTION.

In the following table is given the production of Roumania, by districts and months, during the year 1905, in metric tons:

Production of crude petroleum in Roumania in 1905, by districts and months.

[Metric tons.]

Month.	District Prahova.				Dimbovitza.	Buzeu.	Bacau.	Total.
	Bustenari.	Campina-Poiana.	Other.	Total.				
January	28,545	7,187	2,604	38,336	2,222	889	649	42,096
February	30,197	8,007	2,253	40,457	2,023	844	529	43,853
March	30,366	8,640	2,300	41,306	2,250	984	644	45,184
April	31,218	9,264	2,714	43,196	1,930	999	813	46,938
May	34,021	6,869	3,783	44,673	2,183	937	859	48,652
June	34,982	6,632	3,864	45,478	2,562	1,300	792	50,132
July	36,508	6,927	3,608	47,043	2,134	1,416	617	51,210
August	34,725	9,795	4,620	49,140	2,033	1,153	868	53,194
September	33,670	6,707	9,554	49,931	1,669	1,128	770	53,498
October	39,910	9,454	9,261	58,625	1,941	1,111	820	62,497
November	38,851	7,732	10,291	56,874	1,984	1,097	834	60,789
December	38,414	7,646	7,180	53,240	1,772	1,046	779	56,837
Total	411,407	94,860	62,032	568,299	24,703	12,904	8,974	614,880

In the following table is given the production of Roumania, by districts, for the last five years:

Production of crude petroleum in Roumania, 1901 to 1905, by districts.

[Metric tons.]

District.	1901.	1902.	1903.	1904.	1905.
Prahova	233,000	259,000	345,913	455,354	568,299
Dimbovitza	17,000	33,000	22,469	26,234	24,703
Bacau	14,000	13,000	10,000	10,145	8,974
Buzeu	6,000	5,000	5,920	8,828	12,904
Total	270,000	310,000	384,302	500,561	614,880

In the following table will be found the production of crude petroleum in the principal districts in Roumania from 1901 to 1905, inclusive:

Production of crude petroleum in Roumania, by districts, 1901–1905.

[Tank cars of 22,046 pounds reduced to barrels of 42 gallons.]

Year.	District.				Total.	
	Prahova.	Buzeu.	Bacau.	Dimbovitza.	Tank cars.	Barrels (42 U.S. gallons).
1901	19,090	333	1,325	2,562	23,310	1,678,320
1902	23,600	650	1,500	2,900	28,650	2,059,935
1903	34,591	592	1,000	2,247	38,430	2,763,117
1904	45,535	883	1,015	2,623	50,056	3,599,026
1905	56,830	1,290	898	2,470	61,488	4,420,987

1 wagon or tank car=10 tons.
1 ton=7.19 barrels.

WELL RECORD IN ROUMANIA.

Pits dug by hand and drilled wells operated in Roumania in 1904 and 1905, by districts; also pits and wells abandoned, work suspended, in preparation, and pits and wells productive.

District.	1904.						1905.					
	Pits dug by hand.			Drilled wells.			Pits dug by hand.			Drilled wells.		
	Abandoned.	In preparation.	Productive.	Abandoned.	In preparation.	Productive.	Abandoned.	In preparation.	Productive.	Abandoned.	In preparation.	Productive.
Prahova	685	105	332	114	95	167	723	70	276	142	197	276
Dimbovitza	90	28	94	3	8	8	145	21	93	10	13	10
Buzeu	160	40	49	9	3	6	168	16	67	28	......	8
Bacau	194	2	268	22	1	39	194	26	244	42	5	46
Total	1,129	175	743	148	107	220	1,132	133	680	222	215	340

ROUMANIAN REFINERIES.

The following tables show the production of Roumanian refineries in 1904 and 1905:

Production of the refineries of Roumania in 1904 and 1905, by districts.

[Metric tons.]

District.	Crude petroleum manufactured.	Manufactured in 1904.				Delivered for consumption in 1904.			
		Benzine.	Refined oil.	Lubricating oil.	Residuum.	Benzine.	Refined oil.	Lubricating oil.	Residuum.
Bacau	9,893	870	4,176	2,082	1,712	24	4,603	291	751
Buzeu	2,357	340	866	63	805	18	928	14	534
Constantza	29,175	6,945	5,811	3,411	12,468	1	1,252	....	7,360
Covurlui	601	91	187	29	266	19	245	18	32
Dimbovitza	36,764	5,503	9,941	2,041	17,506	55	8,023	732	10,368
Ilfov	2,378	377	617	222	1,172	212	4,262	1,591	2,359
Neamtzu	1,545	65	724	298	197	2	805	48	165
Prahova	306,486	47,888	86,468	21,789	138,902	155	11,535	680	97,548
Putna	543	18	200	105	155	1	223	15	175
R. Sarat	996	108	248	78	329	1	281	11	360
Tutova	649	13	272	96	149	1	283	18	83
Total	391,387	62,218	109,510	30,214	173,661	489	32,440	3,418	119,735

District.	Crude petroleum manufactured.	Manufactured in 1905.				Delivered for consumption in 1905.			
		Benzine.	Refined oil.	Lubricating oil.	Residuum.	Benzine.	Refined oil.	Lubricating oil.	Residuum.
Bacau	7,404	678	3,275	1,509	1,320	28	3,835	299	1,066
Buzeu	1,176	151	415	63	488	23	486	29	321
Constantza	41,273	12,416	9,642	366	18,300	6	1,596	134	12,061
Covurlui	699	94	240	44	309	15	310	51	62
Dimbovitza	38,842	4,009	11,370	1,435	19,160	20	8,629	1,201	15,170
Ilfov	2,977	458	793	457	1,133	420	4,070	2,288	2,256
Neamtzu	519	20	257	95	72	....	338	58	176
Prahova	415,860	60,241	127,025	13,114	196,509	91	11,823	782	130,736
Putna	535	13	238	98	127	1	192	32	175
R. Sarat	703	99	180	46	222	11	200	11	163
Tutova	155	3	64	28	37	....	79	36	57
Total	510,143	78,182	153,499	17,255	237,677	615	31,558	4,921	162,243

Production of the refineries of Roumania, 1901–1905.

[Kilograms.]

Year.	Crude petroleum manufactured.	Benzine.	Refined oil.	Lubricating oil.	Residuum.
1901	195,316,771	25,575,025	53,691,675	12,592,114	84,424,574
1902	215,574,930	31,166,618	56,814,913	10,524,815	104,366,004
1903	314,748,122	48,225,279	76,443,449	38,057,186	132,362,236
1904	391,387,000	62,218,000	109,510,000	30,214,000	173,661,000
1905	510,143,000	78,182,000	153,499,000	17,255,000	237,677,000

Delivered from refineries of Roumania for consumption in 1901 to 1905.

[Kilograms.]

Year.	Benzine.	Refined oil.	Lubricating oil.	Residuum.
1901	553,744	30,904,373	844,118	66,753,325
1902	496,362	32,210,189	3,355,170	77,876,272
1903	1,090,066	30,272,652	3,719,616	97,098,540
1904	489,000	32,440,000	3,418,000	119,735,000
1905	615,000	31,558,000	4,921,000	162,243,000

CONSUMPTION AND EXPORT.

The following table shows consumption and export of refined products:

Quantity and value of petroleum products in and exports from Roumania in 1903, 1904, and 1905.

[Metric tons.]

	1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Domestic consumption.		*Francs.*		*Francs.*		*Francs.*
Benzine	1,090	174,410	489	73,594	615	98,250
Refined oil	30,273	3,027,265	32,440	3,244,000	31,558	3,313,590
Lubricating oil	3,719	595,138	3,418	615,240	4,921	836,570
Residuum	97,098	3,398,448	119,735	3,615,997	162,243	4,867,290
Total	132,180	7,195,261	156,082	7,548,831	199,337	9,115,700
Exported.						
Benzine	21,606	1,944,540	36,969	2,957,520	46,699	3,969,415
Refined oil	45,897	2,753,820	78,270	5,478,900	118,134	8,269,380
Crude, residuum, and gas oil.	58,724	2,348,920	45,204	2,260,200	49,515	2,228,175
Total	126,227	7,047,280	160,443	10,696,620	214,348	14,466,970
Grand total	258,407	14,242,541	316,525	18,245,451	413,685	23,582,670

The following table shows the distribution of petroleum and its products exported from Roumania during the years 1902 to 1905, inclusive, by countries:

Exports of petroleum and its products from Roumania from 1902 to 1905, by countries.

[Metric tons.]

Country.	Crude oil and residuum.				Refined.			
	1902.	1903.	1904.	1905.	1902.	1903.	1904.	1905.
Germany	175	....	143	82	11,698	10,694	14,258	19,109
England	7,565	32,035	18,141	15,140	13,823	5,050	15,588	7,430
Austria-Hungary	13,430	19,334	18,987	18,686	1,175	21	68	13
Belgium	22	22	....	87	....	45	22	....
Bulgaria	1,570	1,095	1,732	1,245	1,741	2,793	3,231	3,343
France	....	3,455	2,335	11,790	....	5,035	25,089	79,766
Greece	....	17	....	....	2	276	158	....
Holland	2	2,544	24	....	....	10,829	10,208	....
Italy	....	27	42	52	491	10,104	7,984	....
Servia	6	7	34	544	1	....	....	....
Switzerland	59	....	12	1	11	24	45	12
Turkey	243	188	477	747	182	1,026	1,617	6,851
Philippines	5	....	....	....	....	....	....	....
Norway	....	....	3,277	1,141	3,167	....	....	1,610
Russia	2	....	....	....	....	....	....	....
Total	23,079	58,724	45,204	49,515	32,291	45,897	78,270	118,134

Country.	Benzine.				Total.			
	1902.	1903.	1904.	1905.	1902.	1903.	1904.	1905.
Germany	13,537	13,577	11,355	17,900	25,410	24,271	25,757	37,091
England	6	....	3,139	....	21,394	37,086	36,869	22,570
Austria-Hungary	263	1,357	3,052	541	14,868	20,712	22,107	19,240
Belgium	240	97	....	....	262	164	22	87
Bulgaria	27	21	32	55	3,338	3,909	4,995	4,643
France	1,476	4,659	13,207	27,369	1,476	13,149	40,631	118,925
Greece	2	6	8	....	4	299	166	....
Holland	29	1,624	6,012	....	31	14,998	16,244	....
Italy	39	10	9	25	530	10,140	8,026	77
Servia	1	....	....	160	8	7	34	704
Switzerland	493	228	63	12	563	250	119	25
Turkey	31	27	6	62	456	1,241	2,100	7,660
Philippines	....	....	....	....	5	....	....	....
Norway	201	....	29	....	3,368	....	3,306	2,751
Russia	....	....	....	575	2	....	....	575
Denmark	....	....	42	....	....	....	42	....
Egypt	....	....	25	....	....	....	25	....
Total	16,345	21,606	36,969	46,699	71,715	126,227	160,443	214,348

GERMANY.

PRODUCTION.

In the following table is shown the quantity and value of petroleum produced in the German Empire, by states, from 1901 to 1905:

Production and value of petroleum in the German Empire, 1901–1905, by states.

Year.	Alsace-Lorraine.	Prussia and Bavaria.	Total.		Total value.	
	Quantity.	Quantity.	Quantity.			
	Metric tons.	*Metric tons.*	*Metric tons.*	*Barrels (42 gallons).*	*Marks.*	*Dollars.*
1901	19,997	24,098	44,095	313,630	2,950,478	708,115
1902	20,205	29,520	49,725	353,674	3,351,000	804,240
1903	20,947	41,733	62,680	445,818	4,334,000	1,040,160
1904	22,016	67,604	89,620	637,431	5,805,000	1,393,200
1905	21,128	57,741	78,869	560,963	5,207,000	1,249,680

1 metric ton, crude=7.1126 barrels.
1,000 kilos=1 metric ton=2,204.62 pounds.
100 kilos=0.8 barrel—for refined petroleum (approximate).
100 kilos=0.7 barrel—for crude petroleum (approximate).

EXPORTS.

Exports of petroleum from Germany, 1901–1904, by kinds.

[Metric tons.]

Kind.	1901.	1902.	1903.	1904.
Crude oil	....	....	13	83
Petroleum refined in foreign countries	47	51	52	45
Petroleum refined in Germany	555	824	701	760
Distillate, crude benzine, etc., manufactured in foreign countries	290	272	182	270
Distillate, crude benzine, etc., manufactured in Germany	3,681	3,793	5,052	6,318
Lubricating oil manufactured in foreign countries	1,335	1,342	1,226	1,505
Lubricating oil manufactured in Germany	963	1,176	1,975	1,762
Earth wax and ceresin	1,700	1,856	2,026	2,149
Total	8,571	9,314	11,227	12,892

IMPORTS.

Imports of petroleum and its products into Germany, 1901–1905, by kinds.

[Metric tons.]

Kind.	1901.	1902.	1903.	1904.	1905.
Crude petroleum	10,102	6,721	3,244	2,178	1,081
Refined petroleum	911,794	926,561	970,428	970,596	948,478
Distillate, crude benzine, etc	5,565	5,846	6,498	6,843	9,749
Lubricating oil	118,999	125,666	147,837	142,929	143,926
Mineral oils for refining	58,141	67,699	87,526	96,706	110,944
Mineral oil for other purposes than illumination, lubrication, and gas	4,036	4,013	4,485	4,261	....
Earth wax and ceresin	87	77	90	111	....
Other products	....	....	6,719	5,559	11,782
Total	1,108,724	1,136,583	1,226,827	1,229,183	1,225,960

Imports of petroleum and its products into Germany, 1903–1905, by countries.

[Metric tons.]

Country.	1903.	1904.	1905.
United States	849,053	854,446	860,991
Russia	219,454	208,665	186,816
Austria-Hungary	54,991	58,095	64,050
Dutch East Indies	36,276	47,959	62,507
Roumania	27,396	29,932	20,934
Other countries	39,657	30,086	30,662
Total	1,226,827	1,229,183	1,225,960

In the following table is given a statement of the imports of petroleum into Germany from the United States for the fiscal years 1901 to 1905:

Imports of petroleum into Germany from the United States for the fiscal years 1901–1905.

[Gallons.]

Year ending June 30—	Crude.	Refined.		
		Naphtha.	Illuminating.	Lubricating.
1901	4,214,041	4,940,546	136,399,456	8,921,513
1902	6,848,989	7,852,195	133,241,233	9,542,846
1903	6,338,191	1,866,357	111,336,427	11,670,529
1904	3,990,063	....	113,069,001	11,421,404
1905	5,669,934	3,258,042	126,577,304	12,385,112

ITALY.

PRODUCTION.

In the following tables will be found the production of crude petroleum in Italy during the year 1904, by districts, and the production each year since 1901 with the value per unit and the total value. These tables are taken from the volumes of Rivista del Servizio Minerario.

Production of crude petroleum in Italy during the year 1904, by districts.

Mining district.	Province.	Number of wells in operation.	Quantity.		Value.			
			Metric tons.	Barrels of 42 gallons.	Per ton.	Per barrel.	Total.	
					Lire.	*Dollars.*	*Lire.*	*Dollars.*
Milan	Parma	7	69	496	263.78	7.04	18,104	3,494
	Piacenza	2	3,432	24,678	300.10	8.05	1,030,040	198,798
Rome	Chieti	1	42	302	122.62	3.29	5,150	994
Total	....	10	3,543	25,476	297.28	7.98	1,053,294	203,286

Production of crude petroleum in Italy, 1901–1904.

Year.	Number of wells in operation.	Quantity.		Value.				Number of workmen employed
		Metric tons.	United States barrels.	Unit value.		Total value.		
				Lire.	Dollars.	Lire.	Dollars.	
1901	9	2,246	16,150	298.78	8.02	671,065	129,515	227
1902	9	2,633	18,933	295.54	7.93	778,163	150,185	252
1903	10	2,486	17,876	296.57	7.96	737,293	142,298	282
1904	10	3,543	25,476	297.28	7.98	1,053,294	203,286	367

7.1905 barrels=1 metric ton of crude. 7.955 barrels=1 metric ton of refined. 1 lira=19.3 cents.

Production of refined petroleum in Italy, 1901–1904.

Year.	Number of works.	Quantity.		Value.				Number of laborers.
		Metric tons.	Barrels of 42 gallons.	Per ton.	Per barrel.	Total.		
				Lire.		Lire.		
1901	11	4,211	33,498	494.66	$12.00	2,083,039	$402,026	200
1902	9	4,413	35,105	427.60	10.37	1,887,002	364,191	120
1903	10	4,577	36,410	386.09	9.37	1,767,126	341,055	221
1904	11	6,568	52,248	347.43	8.43	2,281,903	440,408	225

Production of refined petroleum in Italy in 1904, by districts.

Mining district.	Province.	Number of works.	Kind of product.	Production.						Number of laborers.
				Quantity.		Value.				
				Metric tons.	Barrels of 42 gallons.	Per ton.	Per barrel.	Total.		
						Lire.		Lire.		
Carrara	Genova	1	Benzine	180	1,432	500.00	$12.13	90,000	$17,370	225
Milano	Milano	2	Light	2,542	20,222	557.50	13.52	1,417,178	273,515	
	Parma	1	Benzine	707	5,624	532.57	12.92	376,530	72,670	
	Piacenza	1	Heavy	724	5,759	80.95	11.96	58,605	11,311	
Napoli	Napoli	1	Light	54	430	680.00	16.48	36,720	7,087	
			Heavy	864	6,873	130.00	3.15	112,320	21,678	
Roma	Chieti	2	Benzine	12	95	250.00	6.09	3,000	579	
			Heavy	285	2,267	131.06	3.18	37,350	7,209	
Torino	Alessandria, Torino	3	Heavy	1,200	9,546	125.17	3.03	150,200	28,989	
Total		11		6,568	52,248	347.43	8.43	2,281,903	440,408	

IMPORTS AND EXPORTS.

Quantity of crude mineral oils imported into and exported from Italy, 1900–1904.

[Metric tons.]

Year.	Imports.	Exports.	Year.	Imports.	Exports.
1900	19,610	109	1903	24,387	325
1901	18,215	117	1904	25,468	178
1902	21,599	394			

Quantity of refined illuminating petroleum imported into Italy, 1900–1904.

Year.	Metric tons.	Barrels.	Year.	Metric tons.	Barrels.
1900	73,089	581,423	1903	68,220	542,690
1901	69,298	551,265	1904	69,233	550,749
1902	68,781	547,153			

Quantity and value of crude and refined petroleum imported from the United States into Italy, 1901–1905.

[Gallons.]

Year ending June 30—	Crude.		Illuminating.		Lubricating.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1901	259	$23	21,402,629	$1,150,995	1,965,691	$318,932
1902	3,250	185	21,362,433	1,073,310	2,865,719	415,660
1903	7,641	383	a 24,177,499	a 1,250,526	2,925,126	459,722
1904			12,736,187	721,219	2,961,857	457,506
1905 b			23,048,026	1,147,949	3,528,671	486,509

a Includes 1,500 gallons of naphtha, valued at $242.
b Also 2,173,947 gallons of naphtha, valued at $173,095, were imported.

GREAT BRITAIN.

OIL SHALE.

In the following table is shown the production of oil shale produced in Great Britain during the years 1902 to 1904, inclusive, taken from the Mineral Statistics of the United Kingdom:

Quantity and value of oil shale produced in Great Britain, 1902–1904.

[Long tons.]

Country.	1902.		1903.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
England			193	£58		
Scotland	2,105,953	£500,211	2,009,265	477,200	2,331,885	£553,905
Wales	1,581	593	144	54	1,177	441
Total	2,107,534	500,804	2,009,602	477,312	2,333,062	554,346

IMPORTS.

The board of trade reports the following:

Quantity of petroleum imported into the United Kingdom during the years 1904 and 1905, by kinds and countries.

1904.

[Imperial gallons.]

Kind.	United States.	Russia.	Dutch East Indies, except Borneo, Java, and New Guinea.	Other countries.	Total.
Lubricating	28,548,505	13,451,964	....	2,833,287	44,833,756
Illuminating	83,574,009	87,999,145	....	5,976,930	177,550,084
Crude	1,183,490	....	....	5,030	1,188,520
Spirit	5,960,701	....	4,402,250	1,609,508	11,972,459
Gas oil	23,888,487	28,146,067	....	6,394,880	58,429,434
Fuel oil	8,004,440	....	....	152,450	8,156,890
Total	151,159,632	129,597,176	4,402,250	16,972,085	302,131,143

1905.

Kind.	United States.	Russia.	Dutch East Indies, except Borneo, Java, and New Guinea.	Other countries.	Total.
Lubricating	35,169,980	7,467,874	....	4,886,200	47,524,054
Illuminating	101,429,757	49,648,120	....	6,187,218	157,265,095
Crude	487,430	....	....	13,239	500,669
Spirit	10,527,066	....	6,315,000	1,816,325	18,658,391
Gas oil	47,547,913	11,374,911	....	4,840,941	63,763,765
Fuel oil	11,555,972	....	....	742,409	12,298,381
Total	206,718,118	68,490,905	6,315,000	18,486,332	300,010,355

The shipment of refined petroleum oil from America, Russia, Roumania, and Galicia to the United Kingdom during 1904 and 1905 have been, according to Messrs. Henry Funck's circular, as follows:

Shipments of refined petroleum to the United Kingdom in 1904 and 1905, by ports.

[Barrels.]

Port.	1904.				1905.				
	American.	Russian.	Roumanian.	Total.	American.	Russian.	Roumanian.	Galician.	Total.
Barrow-in-Furness	55,390	33,900	....	89,290	6,617	....	....	....	6,617
Belfast	71,360	108,500	....	179,860	66,526	95,279	....	....	161,805
Bristol and Avonmouth	221,156	96,954	....	318,110	283,799	23,110	....	....	306,909
Cardiff	....	137,278	....	137,278	....	81,743	....	....	81,743
Dublin	82,858	21,000	....	103,858	144,292	....	....	....	144,292
Hull	118,542	171,809	....	290,351	178,853	95,589	....	26,050	300,492
Limerick	....	27,100	....	27,100	....	35,100	....	....	35,100
Liverpool and Birkenhead	201,444	62,570	20,000	284,014	224,515	43,801	....	31,450	299,766
London	883,468	859,125	88,000	1,830,593	1,012,273	397,570	66,800	58,590	1,535,233
Manchester	123,779	367,683	....	491,462	241,360	271,904	....	....	513,264
Plymouth	44,415	9,000	....	53,415	48,940	....	....	....	48,940
Shields	66,340	87,000	20,000	173,340	55,550	39,822	....	5,580	100,952
Southampton	102,053	32,500	....	134.553	111,363	6,300	....	9,799	127,462
Sunderland	56,593	15,500	....	72,093	104,850	....	....	....	104,850
Total [a]	2,027,398	2,029,919	128,000	4,185,317	2,478,938	1,090,218	66,800	131,469	3,767,425

[a] Exclusive of shipments of oil in barrels by general-cargo steamers.

Total imports of refined petroleum into the United Kingdom, 1901–1905.

[Barrels.]

Year.	American.	Russian.	Roumanian.	Galician.	Total.
1901	2,619,283	1,200,316	51,492	....	3,871,091
1902	2,515,051	1,732,493	65,500	....	4,313,041
1903	2,083,627	2,202,120	31,000	....	4,316,747
1904	2,027,398	2,029,919	128,000	....	4,185,317
1905	2,478,938	1,090,218	66,800	131,469	3,767,425

Quantity of petroleum oils imported from the United States into the United Kingdom for fiscal years 1901–1905, as reported by Bureau of Statistics, Department of Commerce and Labor.

[U. S. gallons.]

Year ending June 30—	Crude.	Refined.		
		Naphthas.	Illuminating.	Lubricating.
1901	2,547,501	7,340,307	169,548,529	26,762,400
1902	7,531,278	8,259,392	211,228,093	28,084,029
1903	17,769,325	2,376,877	149,281,493	34,854,074
1904	12,021,692	5,942,545	165,248,727	33,890,901
1905	14,075,577	11,806,289	174,057,928	35,571,115

PRICES.

The following table shows the prices of American and Russian refined oil in English markets in 1905:

Prices of American and Russian refined oil in English markets in 1905.

[In pence per English gallon.]

	London.		Liverpool.	
	American.	Russian.	American.	Russian.
January 6	$5\frac{1}{2}$	$4\frac{7}{8}$	$6\frac{1}{4}-8$	$5\frac{3}{4}$
January 13	$5\frac{3}{8}$	$4\frac{3}{4}$	$5\frac{1}{2}-7\frac{1}{2}$	$5\frac{1}{2}$
January 20	$5\frac{3}{8}$	$4\frac{3}{4}$	$6-7\frac{1}{2}$	$5\frac{1}{2}$
January 27	$5\frac{3}{8}$	$4\frac{3}{4}-4\frac{7}{8}$	$6-7\frac{1}{2}$	$5\frac{1}{2}$
February 3	$5\frac{3}{8}$	$4\frac{3}{4}-4\frac{7}{8}$	$6-7\frac{1}{2}$	$5\frac{1}{2}$
February 10	$5\frac{3}{8}$	$4\frac{3}{4}-4\frac{7}{8}$	$6-7\frac{1}{2}$	$5\frac{1}{2}$
February 17	$5\frac{1}{8}-5\frac{1}{4}$	$4\frac{5}{8}-4\frac{3}{4}$	$6-7\frac{1}{2}$	$5\frac{1}{2}$
February 24	$5\frac{1}{8}-5\frac{1}{4}$	$4\frac{3}{8}-4\frac{3}{4}$	$6-7\frac{1}{2}$	$5\frac{1}{2}$
March 3	$5\frac{1}{8}-5\frac{1}{4}$	$4\frac{3}{8}-4\frac{3}{4}$	$6-7\frac{1}{2}$	$5\frac{1}{2}$
March 10	$5\frac{1}{8}-5\frac{1}{4}$	$4\frac{3}{4}-4\frac{7}{8}$	$6-7\frac{1}{2}$	$5\frac{1}{4}$
March 17	$5\frac{1}{8}$	$4\frac{3}{4}-4\frac{7}{8}$	$6-7\frac{1}{2}$	$5\frac{1}{4}$
March 24	$5\frac{1}{8}$	$4\frac{3}{4}$	$6-7\frac{1}{2}$	$5\frac{1}{4}$
March 31	$5\frac{1}{8}$	$4\frac{3}{4}$	$6-7\frac{1}{2}$	$5\frac{1}{4}$
April 7	$5\frac{1}{8}$	$4\frac{5}{8}$	$6-7\frac{1}{2}$	$5\frac{1}{4}$
April 14	$5\frac{1}{8}$	$4\frac{5}{8}$	$6-7\frac{1}{2}$	$5\frac{1}{4}$
April 21	$5\frac{1}{8}$	$4\frac{5}{8}$	$6-7\frac{1}{2}$	$5\frac{1}{4}$
April 28	$5\frac{1}{8}$	$4\frac{5}{8}$	$6-7\frac{1}{2}$	$5\frac{1}{4}$
May 5	$5\frac{1}{8}$	$4\frac{5}{8}$	$6-7\frac{1}{2}$	$5\frac{1}{4}$
May 12	$5\frac{1}{8}$	$4\frac{3}{4}$	$6-7\frac{1}{2}$	$5\frac{1}{4}$
May 19	$5\frac{1}{8}$	$4\frac{3}{4}$	$5\frac{3}{4}-7\frac{1}{4}$	5
May 26	$5\frac{1}{8}$	$4\frac{3}{4}$	$5\frac{3}{4}-7\frac{1}{4}$	5

Prices of American and Russian refined oil in English markets in 1905—Continued.

[In pence per English gallon.]

	London.		Liverpool.	
	American.	Russian.	American.	Russian.
June 2	$5\frac{1}{8}$	$4\frac{3}{4}$	$5\frac{3}{4}$–$7\frac{1}{4}$	5
June 9	$5\frac{1}{8}$	$4\frac{3}{4}$	$5\frac{3}{4}$–$7\frac{1}{4}$	5
June 16	$5\frac{1}{4}$	$4\frac{7}{8}$	$5\frac{3}{4}$–$7\frac{1}{4}$	5
June 23	$5\frac{1}{4}$	$4\frac{7}{8}$	$5\frac{3}{4}$–$7\frac{1}{4}$	5
June 30	$5\frac{3}{8}$–$5\frac{1}{2}$	5	$5\frac{3}{4}$–$7\frac{1}{4}$	5
July 7	$5\frac{3}{8}$–$5\frac{1}{2}$	5	$5\frac{3}{4}$–$7\frac{1}{4}$	5
July 14	$5\frac{7}{8}$–6	$5\frac{1}{2}$	6 –$7\frac{1}{2}$	$5\frac{1}{2}$
July 21	$5\frac{5}{8}$–$5\frac{3}{4}$	$5\frac{1}{4}$	6 –$7\frac{1}{2}$	$5\frac{1}{2}$
July 28	$5\frac{5}{8}$–$5\frac{3}{4}$	$5\frac{1}{4}$	6 –$7\frac{1}{2}$	$5\frac{1}{2}$
August 4	$5\frac{5}{8}$–$8\frac{3}{4}$	$5\frac{1}{4}$	6 –$7\frac{1}{2}$	$5\frac{1}{2}$
August 11	$5\frac{5}{8}$–$8\frac{3}{4}$	$5\frac{1}{8}$–$5\frac{1}{4}$	6 –$7\frac{1}{2}$	$5\frac{1}{4}$
August 18	$5\frac{5}{8}$	$5\frac{1}{8}$–$5\frac{1}{4}$	6 –$7\frac{1}{2}$	5
August 25	$5\frac{5}{8}$	$5\frac{1}{4}$	6 –$7\frac{1}{2}$	5
September 1	$5\frac{5}{8}$	$5\frac{1}{4}$	6 –$7\frac{1}{2}$	5
September 8	$5\frac{5}{8}$	$5\frac{1}{4}$	6 –$7\frac{1}{2}$	5
September 15	$5\frac{5}{8}$	$5\frac{1}{4}$	6 –$7\frac{1}{2}$	5
September 22	$5\frac{7}{8}$	$5\frac{1}{2}$	6 –$7\frac{1}{2}$	$5\frac{1}{2}$
September 29	$5\frac{7}{8}$	$5\frac{1}{2}$	6 –$7\frac{1}{2}$	$5\frac{1}{2}$
October 6	$6\frac{1}{8}$	$5\frac{1}{2}$–$5\frac{3}{4}$	6 –$7\frac{1}{2}$	$5\frac{1}{2}$
October 13	$6\frac{7}{8}$–7	$6\frac{3}{8}$–$6\frac{1}{2}$	$6\frac{3}{4}$–$8\frac{1}{4}$	$6\frac{1}{4}$
October 20	$6\frac{3}{4}$–$6\frac{7}{8}$	$6\frac{1}{4}$–$6\frac{3}{8}$	$6\frac{3}{4}$–$8\frac{1}{4}$	$6\frac{1}{4}$
October 27	$6\frac{3}{4}$–$6\frac{7}{8}$	$6\frac{1}{4}$–$6\frac{3}{8}$	$6\frac{3}{4}$–$8\frac{1}{4}$	$6\frac{1}{4}$
November 3	$7\frac{1}{8}$–$7\frac{1}{4}$	$6\frac{5}{8}$–$6\frac{3}{4}$	$6\frac{3}{4}$–$8\frac{1}{4}$	$6\frac{1}{4}$
November 10	$7\frac{1}{8}$	$6\frac{5}{8}$–$6\frac{3}{4}$	$7\frac{1}{2}$–$8\frac{1}{4}$	$6\frac{1}{4}$
November 17	$7\frac{1}{8}$–$7\frac{1}{4}$	$6\frac{5}{8}$–$6\frac{3}{4}$	$7\frac{1}{2}$–$8\frac{1}{4}$	$6\frac{1}{4}$
November 24	$7\frac{1}{2}$–$7\frac{5}{8}$	$7\frac{1}{8}$	$7\frac{1}{2}$–$8\frac{1}{4}$	$7\frac{1}{4}$
December 1	$7\frac{1}{2}$–$7\frac{5}{8}$	$7\frac{1}{8}$	$7\frac{1}{2}$–$8\frac{1}{4}$	7
December 8	$7\frac{1}{4}$–$7\frac{1}{2}$	$6\frac{7}{8}$	7 –8	7
December 15	$7\frac{1}{8}$	$6\frac{1}{2}$	7 –$7\frac{1}{2}$	$6\frac{3}{4}$
December 22	$6\frac{7}{8}$	$6\frac{1}{4}$	$7\frac{1}{4}$–$8\frac{3}{4}$	$6\frac{3}{4}$
December 29	$6\frac{7}{8}$	$6\frac{1}{4}$	$7\frac{1}{4}$–$8\frac{3}{4}$	$6\frac{3}{4}$

INDIA.

PRODUCTION.

The following tables give the production and value of petroleum in India from 1901 to 1905, by provinces:

Production and value of petroleum in India, 1901–1905, by provinces.

QUANTITY.

[Imperial gallons.]

Year.	Burma.	Assam.	Punjab.	Total.
1901	49, 441, 734	631, 571	1, 812	50, 075, 117
1902	54, 848, 980	1, 756, 759	1, 949	56, 607, 688
1903	85, 328, 491	2, 528, 785	1, 793	87, 859, 069
1904	115, 903, 804	2, 585, 920	1, 658	118, 491, 382
1905	142, 063, 846	2, 733, 110	1, 488	144, 798, 444

Production and value of petroleum in India, 1901–1905, by provinces—Continued.

VALUE.

[Rupees.]

Year.	Burma.	Assam.	Punjab.	Total.
1901	3,031,595	33,252	284	3,065,131
1902	3,179,001	87,838	406	3,267,245
1903	5,188,638	126,439	393	5,315,470
1904	6,947,556	161,620	390	7,109,566
1905	8,891,907	170,819	325	9,063,051

The following table gives the production of petroleum in India from 1901 to 1905 in imperial gallons reduced to barrels of 42 gallons and in rupees reduced to dollars:

Production and value of petroleum in India, 1901–1905.

Year.	Quantity.		Value.	
	Imperial gallons.	Barrels (42 United States gallons).	Rupees.	Dollars.
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
1905	144,798,444	4,137,098	9,063,051	2,936 429

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.

IMPORTS.

Imports of mineral oil from the United States into British East Indies, 1901–1905.

[Gallons.]

Year ending June 30—	Naphtha.		Illuminating.		Lubricating.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1901			10,712,570	$964,385	5,942,778	$717,045
1902	1,000	$195	10,364,540	872,660	4,503,826	564,841
1903	19,000	3,725	10,130,090	997,384	6,016,107	602,188
1904	62,500	13,437	9,677,103	1,090,407	5,983,203	686,273
1905	86,600	15,164	19,170,900	1,558,681	4,753,101	460,388

Imports of kerosene into British India by sea, 1901–1906, by countries.

[Gallons.]

Year.	British empire.	United States.	Russia.	Borneo.	Sumatra.	Other countries.
1901-2	1,220,999	5,768,226	84,477,876			365
1902-3	810,344	9,229,244	71,125,438		285,990	239
1903-4	3,795,822	6,722,131	57,319,835	2,372,003	1,347,658	1,144
1904-5	11,976,089	7,476,976	40,304,136	9,280,873	5,943,197	1,208,802
1905-6	10,405,707	22 332,356	7,616,685	5,192,661	5,400,852	598

Imports of mineral oils into British India by sea, 1901–1906, by countries.

[Gallons.]

Year.	Total kerosene.	Total other mineral oils.	Total. Quantity.	Total. Value.
				Rupees.
1901-2	91,467,466	7,418,739	98,886,205	38,376,667
1902-3	81,451,255	7,421,989	88,873,244	34,645,502
1903-4	71,558,593	8,963,341	80,521,934	34,493,344
1904-5	76,190,067	7,441,100	83,631,167	33,250,547
1905-6	50,948,859	10,157,326	61,106,185	22,289,875

DUTCH EAST INDIES.

PRODUCTION.

No official figures have been obtained for the production in Sumatra, Java, and Borneo for the year 1905.

The following table shows the production for the year 1904 from these three islands, with estimated figures for the year 1905:

Production of crude petroleum in Sumatra, Borneo, and Java, 1904–1905.

[Barrels.]

Country.	1904.	1905.
Sumatra	4,028,551	4,500,000
Borneo	1,489,544	2,468,000
Java	798,074	800,000
Total	6,316,169	7,768,000

The following statistics, given by the Dordtsche Petroleum Maatschappij, Java, show the production of crude and refined petroleum from 1901 to 1905 in the districts of Soerabaya and Rembang:

Production of petroleum in Java, 1901–1905, by districts.

Year.	Residency of Soerabaya. Crude.	Residency of Soerabaya. Refined.	Residency of Rembang. Crude.	Residency of Rembang. Refined.	Total. Crude.	Total. Refined.
	Gallons.	*Cases.*	*Gallons.*	*Cases.*	*Gallons.*	*Cases.*
1901	7,447,888	500,551	5,042,242	1,001,996	12,490,130	1,502,547
1902	5,495,376	310,101	7,949,189	1,225,026	13,444,565	1,535,127
	Liters.	*Liters.*	*Liters.*	*Liters.*	*Liters.*	*Liters.*
1903	28,350,979	15,816,760	76,849,032	47,165,454	105,200,011	62,982,214
1904	48,574,500	27,438,000	78,319,993	44,332,378	126,894,493	71,770,378
1905	50,188,000	29,477,170	77,571,753	44,972,084	127,759,753	74,449,254

IMPORTS.

Quantity and value of refined petroleum imported into the Dutch East Indies from the United States, 1901-1905.

[Gallons.]

Year ending June 30—	Illuminating.		Lubricating.	
	Quantity.	Value.	Quantity.	Value.
1901	17,014,320	$1,492,490	94,966	$16,454
1902	15,025,710	1,363,079	240,400	33,087
1903	9,210,520	864,300	226,436	33,668
1904	10,924,890	1,165,761	282,574	38,427
1905	9,798,770	965,685	191,255	25,309

JAPAN.

PRODUCTION.

In the following table is given the production of crude petroleum in Japan from 1901 to 1905, inclusive:

Production of petroleum in Japan, 1901-1905.

Year.	Production.				Value received for crude and refined sold.	
	Crude.		Refined.[a]			
	Koku.[b]	Gallons.	Koku.[b]	Gallons.	Yen.[c]	Dollars.
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	[d]1,249,536	59,588,214				
1905 [e]	1,186,865	56,328,619		45,812,066		

[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] Production of Echigo.

[e] Not including island of Formosa.

Quantity and value of petroleum imported from the United States into Japan, 1901-1905.

[Gallons.]

Year ending June 30—	Naphtha.		Illuminating.		Lubricating.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1901	1,500	$295	53,299,686	$4,784,350	1,244,878	$197,342
1902	3,646	627	59,598,671	5,195,665	1,246,336	187,138
1903			32,547,509	3,150,162	2,421,772	322,546
1904	103,187	16,115	46,007,530	4,605,672	1,727,057	291,018
1905	255,875	31,575	26,824,694	2,400,142	2,280,867	383,411

In the following table is given the quantity of kerosene imported into Japan from various countries from 1901 to 1905, inclusive:

Quantity and value of kerosene imported into Japan, 1901–1905, by countries.

[Gallons.]

Year.	United States.	Russia.	Other countries.	Total.
1901	52,138,546	10,246,589	[a]6,611,257	68,996,392
1902	57,581,550	17,898,538	66	75,480,154
1903	32,511,201	27,269,005	....	59,780,206
1904	48,811,014	19,987,340	12,873,447	81,671,801
1905	36,817,346	13,002,631	8,882,832	58,702,809

[a] Dutch Indies.

CHINESE EMPIRE.

IMPORTS.

Imports of refined mineral oil from the United States into the Chinese Empire, 1901–1905.

[Gallons.]

Year ending June 30—	Naphthas, including all lighter products of distillation.		Illuminating.		Lubricating and heavy paraffin oil.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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
1905	30,500	4,651	89,368,014	8,186,862	1,062,466	174,611

HONGKONG.

Imports of refined mineral oil from the United States into Hongkong, 1901–1905.

[Gallons.]

Year ending June 30—	Naphtha.		Illuminating.		Lubricating.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1901	....	....	18,708,250	$1,649,200	221,066	$18,464
1902	....	....	17,990,990	1,516,934	482,974	68,922
1903	15,000	$3,300	16,971,990	1,551,963	453,326	67,185
1904	5,000	1,075	22,308,570	2,493,289	379,611	71,790
1905	....	....	18,660,090	1,741,252	451,566	62,317

WORLD'S PRODUCTION.

In the following table is given the figures of the world's production of petroleum during the years from 1902 to 1905, inclusive. This table shows a slight falling off in the year 1905 as against 1904. This is entirely due to the disturbances in Russia, the decrease of that country being 23,576,385 barrels, while the production of the United States increased 17,636,620 barrels as compared with the production of 1904.

The other portions of the world made very little changes in production in 1905 as compared with previous years. Galicia made a slight reduction, while Roumania and India increased their output slightly.

World's production of crude petroleum 1902–1905.

[Barrels of 42 United States gallons.]

Country.	1902.	1903.	1904.	1905.
United States	88,766,916	100,461,337	117,080,960	134,717,580
Russia	80,540,045	75,591,256	78,536,655	54,960,270
Sumatra, Java, and Borneo	5,860,000	6,640,000	6,316,169	a 7,768,000
Galicia	4,142,159	5,234,475	5,947,383	5,765,317
Roumania	2,059,935	2,763,117	3,599,026	4,420,987
India	1,617,363	2,510,259	3,385,468	4,137,098
Japan	1,197,800	1,203,581	1,411,975	1,341,157
Canada	530,624	486,637	552,575	634,095
Germany	353,674	445,818	637,431	560,963
Peru	60,000	61,745	66,200	37,720
Italy	18,933	17,876	25,476	a 25,000
All others	26,000	30,000	40,000	a 30,000
Total	185,173,449	195,446,101	217,599,318	214,398,187

a Estimated.

ADVANCE IN CEMENT TECHNOLOGY, 1905.

By Edwin C. Eckel.

INTRODUCTION.

The statistics presented in the following section of this report can be used as bases for further studies of the condition of the American cement industry. In the present section, therefore, certain points of industrial interest are briefly discussed.

RAW MATERIALS IN USE.

The following table contains data on the production of Portland cement, grouped according to the various combinations of raw material used in its manufacture.

Type 1 includes cement produced from a mixture of argillaceous limestone ("cement rock") and pure limestone. This is the combination of materials used in all the cement plants of the Lehigh district of Pennsylvania and New Jersey, and also at several western plants.

Type 2 includes cement manufactured from a mixture of marl and clay. This type of mixture is used only in the States of Michigan, Ohio, Indiana, and New York.

Type 3 includes cement manufactured from a mixture of soft limestone ("chalks") and clay. This mixture is employed at plants in Alabama, Arkansas, Texas, and South Dakota.

Type 4 includes cement made from a mixture of ordinary hard limestone and clay or shale. This mixture is employed at many plants all over the United States. In order to prevent publication of individual statistics, the Portland cement made from slag and limestone is included in this group. At present the only Portland plants using a slag-limestone mixture are those of the Illinois Steel Company at Chicago, Ill., and Buffington, Ind.

Production and percentage of total output of Portland cement in the United States according to type of material used, 1898–1905.

[Barrels.]

Year.	Type 1. Argillaceous limestone (cement rock) and pure limestone.		Type 2.[a] Marl and clay.		Type 3. Soft limestone (chalk) and clay.		Type 4.[b] Hard limestone and clay or shale.	
	Quantity.	Percentage.	Quantity.	Percentage.	Quantity.	Percentage.	Quantity.	Percentage.
1898	2,764,694	74.9	562,092	15.2	40,120	1.1	325,288	8.8
1899	4,010,132	70.9	1,095,934	19.4	88,200	1.6	458,000	8.1
1900	5,960,739	70.3	1,454,797	17.1	185,686	2.2	880,798	10.4
1901	8,503,500	66.9	2,001,200	15.7	495,752	3.9	1,710,773	13.5
1902	10,953,178	63.6	2,220,453	12.9	373,425	2.1	3,683,588	21.4
1903	12,493,694	55.9	3,052,946	13.7	457,813	2.1	6,338,520	28.3
1904	15,173,391	57.2	3,332,873	12.6	79,500	0.3	7,920,117	29.9
1905	18,454,902	52.4	3,884,178	11.0	235,385	0.7	12,672,347	35.9

[a] Including in the years before 1905 the product from alkali waste and clay at one plant.
[b] Including the product from slag and limestone.

The preceding table, which is a continuation of those which have been published by the writer for a number of years past in Engineering News, shows very clearly the direction in which the American cement industry is trending. Over half of the total product is still made from a mixture of "cement rock" and limestone, but this percentage is slowly decreasing. The marl-clay mixture shows a similar decrease. The proportion of the product made from a mixture of hard limestone and clay or shale is, on the other hand, increasing rapidly.

KILNS AND KILN PRACTICE.

Tables showing the number and types of kilns in use at various dates have been published in this and preceding volumes of Mineral Resources. Omitting vertical or stationary kilns, these figures may be summarized as follows:

Rotary kilns, 1902 and 1905.

	1902.	1905.
Active	456	722
Idle	9	23
Building	46	42

This table shows merely the increase in the number of rotary kilns employed in the American Portland-cement industry during the two years compared. But along with this increase in number there was a marked increase in the rate at which the plants were driven, and in the past few years an equally marked increase in the size of the kiln itself. These factors appear clearly when we compare the output per kiln for the two years: in 1902 each active rotary kiln averaged an output of 36,909 barrels during the year, in 1905 each kiln averaged 48,118 barrels—an increase in kiln efficiency of slightly more than 30 per cent. Part of this increase was due to more steady driving and part to the use of longer kilns. It is probable that during 1906 an average of considerably over 50,000 barrels per kiln per year will be attained.

It may be of interest to determine the total capacity of American plants. Taking into account the number of kilns in use, their sizes, and the raw materials used at the various plants, it is estimated that all the kilns now in operation can produce about 129,000 barrels per day and that before the end of 1906 the total possible daily production will exceed 140,000 barrels.

LOCALIZATION OF THE INDUSTRY.

The present geographic distribution of the cement industry is well shown in the following table. The term East, as here used, includes plants in Pennsylvania, New York, and New Jersey, none being located in New England. The "Central" plants are those in Ohio, Indiana, Illinois, Michigan, and Missouri. Under West are included Kansas, Colorado, South Dakota, and Utah. On the Pacific coast are the three active California plants. The South includes Virginia, West Virginia, Georgia, Alabama, Arkansas, Texas, and Kentucky.

Geographic distribution of Portland-cement industry in 1905.

	East.	Central.	West.	Pacific coast.	South.
Number of plants operating	39	32	7	3	7
Output in barrels, 1905	19,589,675	10,723,802	2,470,349	1,225,429	1,237,557
Percentage of total output	55.6	30.4	7.0	3.5	3.5

CONCENTRATION OF INTERESTS.

At intervals an excited and not particularly well-informed newspaper press inveighs against the enormous profits realized by a purely imaginary cement trust. To those acquainted with the highly competitive nature of the cement industry, in its present stage, such denunciations may seem too absurd for denial, but there is reason to believe that they are accepted as true by the general public. It may, therefore, be of advantage to state that there never has been a cement trust in this country and that at present there seems to be little opportunity for arranging any satisfactory combination of the cement producers. Several years ago a few fairly large companies took up this matter, but as three of the largest plants could not be induced to consider it, the question never reached an advanced stage.

The nature of the industry renders it improbable that any combination or noncompetitive arrangement can be carried through to such a point as to result in a monopoly of the industry and permanently high prices. Good raw materials are so widely distributed throughout the United States that there is hardly a county which could not produce Portland cement if prices were forced high enough. The only limitation now on the erection of cement plants is the fact that they cost too much for an individual or a small firm to enter the business. A plant producing 2,000 barrels per day will require an investment, for land, plant, and working capital, of between $1,000,000 and $1,500,000.

Setting aside as impracticable the question of trusts and combinations based on monopoly of raw materials, it can be said that there is noticeable a certain concentration of interests in the cement industry, and that this will probably become more marked year by year. The 88 plants in existence in 1905 are owned by 78 companies, and several of these nominally independent companies are closely connected in ownership.

Of these 78 companies, 15 produced over two-thirds of the entire American Portland-cement output. Seven of these showed an annual output of over one million barrels each, and these seven together produced somewhat over half of the entire output of the country. To place the matter in a comparative form, the five largest companies together produced about the same percentage of the American cement output that the United States Steel Corporation does of the American output of pig iron. The cement industry is at present, therefore, in a more concentrated condition than was the iron and steel industry at the date of formation of the Steel Corporation, but further concentration, to such a point as to bring about unfairly high prices, does not seem practicable.

Figures obtained unofficially from various sources would indicate that the total authorized capitalization of all the American Portland-cement companies now in operation will fall between the limits of $110,000,000 and $125,000,000. This estimate takes no account of outstanding bond issues, but on the other hand gives no credit for stock authorized but not issued, so that on the whole it can be accepted as representing very fairly the total capitalization of the American Portland-cement industry. This capitalization can not be considered excessive, in view of the fact that it would cost probably $75,000,000 to $85,000,000 to replace the plants and properties now in existence.

STATISTICS OF CEMENT INDUSTRY IN 1905.

By L. L. Kimball.

INTRODUCTION.

The expected bettering of conditions in the cement market came in 1905, and the year closed with a general feeling of satisfaction on the part of conservative manufacturers. Prices were not as high as they had been before the disastrous fall in the market which occurred two seasons ago, but their tendency was upward, the prevailing selling prices throughout the country averaged up so as to show a fair interest on invested capital, and the general condition of trade was indicative of a profitable market during the coming year.

The increase in the output of domestic Portland cement was very large, but it hardly kept pace with the demand, and the year, taken as a whole, showed conclusively the fact that American cements have been successful in practically displacing the various cements imported from other countries. Domestic Portland cements show in the twenty-four hour and the seven-day tests a greater tensile strength than imported cements, in addition to carrying a larger proportion of sand, which facts have helped greatly in steadily decreasing the demand for foreign brands of cement. In addition, the convenience of buying material already at hand, the avoidance of added cost through ocean freightage, and the possibility of deterioration of the cement in the sea air, together with the superior quality of and constant improvements in the cements produced in the United States, have made a condition in the cement world in this country which would have seemed quite impossible ten years ago.

The natural-cement industry in America has declined within the last few years as the Portland-cement industry has grown. In the well-known natural-cement districts many of the plants were idle in 1905, a few were altered with a view to installing machinery for producing Portland cement, some were sold for other uses than the making of cement, and several were torn down. In the Louisville district, where for several years a combine among all the natural-cement producers has existed, most of the plants stood idle, while their quotas were being made by some of the few larger factories that were running, though those mills that were active ran with reduced force and on about half time.

The slag- or puzzolan-cement industry progressed a little in 1905. A large plant to produce puzzolan cement was completed in Kentucky during the year. This industry grows slowly, but its growth has been fairly steady since 1900, when the product was first reported by this Bureau.

At the present time a very interesting demand in the cement industry, and one for which as yet no supply has been produced in the United States, is that for a pure white or absolutely colorless cement. There are a number of deposits of limestone in this country that are practically free from any trace of iron. With the increasing demand for a perfectly white cement for use in joining marbles, for interior finishing and decorations, for taking pale color tints, and for numerous other uses which can not be set forth here, it is probable that before long such an article will be perfectly produced by American manufacturers.

ACKNOWLEDGMENTS.

It is desired to acknowledge here the courtesy with which requests for data as to statistics of production of cement in the United States are met. There is rarely a year when complete returns are not available, and as the statistics published in this report are taken exclusively from data forwarded by cement producers (where, of course, the figures are relative to United States production only), it will be appreciated that such cooperation is advantageous, both to this Bureau and to the people engaged in the cement industry.

Preceding the full report, a preliminary statement of production is annually sent out at as early a date as possible. Early in 1906 a number of requests were received by the Bureau urging the immediate publication of this statement for 1905. In this connection the writer, while expressing thanks for much cordial cooperation and many courtesies, wishes to call attention to the fact that it is impossible to issue the statement of production until the figures are all sent in, and to urge upon the manufacturers the importance of responding promptly in order to make practicable the early issue of the figures showing production of cement, which seems to be so universally desired.

PRODUCTION.

The calendar year 1905 is the record year thus far in the gain marked in total production of hydraulic cements in the United States over the preceding year.

The increase is 8,427,051 barrels of cement in quantity and $9,899,613 in value, which statement shows most clearly the great bettering of conditions in the cement industry in this country in 1905.

The total production of cement for 1905 was 40,102,308 barrels, having a value of $35,931,-533, as compared with a total production in 1904 of 31,675,257 barrels of cement, having a value of $26,031,920.

The production of Portland cement in 1905 was 35,246,812 barrels, valued at $33,245,867.

The production of natural cement in 1905 was 4,473,049 barrels, valued at $2,413,052.

The production of puzzolan cement in 1905 was 382,447 barrels, valued at $272,614.

These figures will be found to vary somewhat from those given in the preliminary statement of production, which is always liable to correction. The change in this instance is due to an error in figures sent by a company that later corrected its mistake. The values given in connection with the various productions of cement for 1905 are much more nearly normal than those shown in the preceding year.

PORTLAND CEMENT.

PRODUCTION.

The following table shows the quantity and value of the production of Portland cement in the States where this article was manufactured in 1903, 1904, and 1905:

Production of Portland cement in the United States in 1903, 1904, and 1905, by States.

[Barrels.]

State.	1903.[a]			1904.[a]			1905.[b]		
	Number of works.	Quantity.	Value.	Number of works.	Quantity.	Value.	Number of works.	Quantity.	Value.
Alabama	1	....	....	1	....	....	1	....	....
Arkansas	1	....	....	1	....	....	1	....	....
California	3	631,151	$1,019,352	3	1,014,558	$1,446,909	3	1,225,429	$1,671,816
Colorado	1	258,773	436,535	1	490,294	638,167	1	786,232	1,172,027
Georgia	1	....	....	1	....	....	1	....	....
Illinois	5	1,257,500	1,914,500	5	1,326,794	1,449,114	5	1,545,500	1,741,150
Indiana	3	1,077,137	1,347,797	4	1,350,714	1,232,071	6	3,127,042	3,134,219
Kansas	1	1,019,682	1,285,310	2	2,643,939	2,134,612	4	....	....
Kentucky	......	....	....	1	....	....	1	....	....
Michigan	13	1,955,183	2,674,780	16	2,247,160	2,365,656	16	2,773,283	2,921,507
Missouri	2	825,257	1,164,834	2	....	....	2	3,879,542	4,164,974
New Jersey	3	2,693,381	2,944,604	3	2,799,419	2,099,564	3	3,654,777	2,775,768
New York	11	1,602,946	2,031,310	11	1,362,514	1,257,561	11	2,111,411	2,044,253
Ohio	8	729,519	998,300	7	910,297	987,899	8	1,312,977	1,390,481
Pennsylvania	17	9,754,313	11,205,892	17	11,496,099	8,969,206	18	13,813,487	11,195,940
South Dakota	1	....	....	1	....	....	1	....	....
Texas	2	....	....	2	....	....	3	....	....
Utah	1	....	....	1	....	....	1	....	....
Virginia	1	538,131	690,105	1	864,093	774,360	1	1,017,132	1,033,732
Washington	......	....	....	......	....	....	1	....	....
West Virginia	1	....	....	1	....	....	1	....	....
Total	76	22,342,973	27,713,319	81	26,505,881	23,355,119	89	35,246,812	33,245,867

[a] The States combined for 1903 and 1904 are mentioned in the text of the reports for those years.
[b] The States combined for 1905 are given in the text below.

State combinations are made in order to avoid the publication of individual figures. Where there is but a single plant in a State or where there is but one plant that was active during a given period, the figures reported are published only in combination with figures showing the total production of neighboring States, unless there is some reason for doing otherwise. In any case where an individual production is given it is with full consent from the proprietors of the plant. In the preceding table the products of Alabama, Georgia, West Virginia, and Virginia are combined; those of Kentucky and Kansas are combined with Missouri; and those of Colorado, Utah, Texas, and South Dakota are combined. In each case the total product of the States is placed against the name of the State contributing the largest quantity of cement to the entire amount.

In 1905 the State of Kentucky had its first production of Portland cement recorded. In addition to this Washington appears for the first time in the list of cement producers, as the new plant there was practically completed though not put into operation in 1905.

Plans for a Portland-cement plant at Mason City, Iowa, are now definitely made, and work on its construction will begin in the spring of 1906. The capacity of the new mill will be about 3,000 barrels of cement per day. There is also reported the formation of the Coos Bay Mining, Milling and Transportation Company, in Portland, Oreg., and its intention to erect a large Portland-cement plant in that State. Besides the fact that there is a large demand and, in proportion to the territory, a small supply of cement in the far West, the building of a cement factory in Oregon would be of more than usual interest, because it was in this State that the first attempt in the United States was made to use the rotary kiln or, as it was then (in 1887) called, the Ransome process of burning and grinding cement. The pioneers were called The Portland Cement Company of Portland, Oreg., and their works were located at Oregon City, in Clackamas County. The material used was a natural Portland-cement rock found in Douglas County. Gas was the fuel used, and power was furnished by the waters of the Willamette River. This company was eventually disrupted through litigation among the stockholders, and since 1890 no cement of any kind has been produced in the State.

In Wisconsin two new plants are projecetd for the production of Portland cement, and the plans for them are reported complete, though building has not begun. They will both use marl and clay for their materials.

In considering the States which were the four largest producers of Portland cement in 1905 it will be noticed that although the rank of the second, the third, and the fourth changes somewhat, Pennsylvania stands, as always, at the head of the line. This time, however, her lead amounts to 10,158,710 barrels, her production being more than 39 per cent of the entire quantity of Portland cement produced in the United States. In 1904 Pennsylvania's lead was smaller, being then but little more than 8,500,000 barrels, though her share of the total production was 40 per cent. The increase in the total production for 1905 was so great that though her production and her lead over the other States were both increased her percentage of the total production was slightly decreased.

New Jersey retains her place as the second largest producer of Portland cement in 1905, with an output which is larger than the one made in 1904 by several hundred thousand barrels and which amounts to something over 10 per cent of the total Portland-cement production.

Indiana, with a production of only about a half million barrels less than that made by New Jersey, displaces Michigan (which ranked third in 1904) and stands third in 1905, though in 1904 she was not in place among the first four producers. Indiana's advance is one of nearly two million barrels and makes her percentage stand as 8.87 of the entire Portland-cement production.

Michigan ranks fourth, notwithstanding the fact that her production of Portland cement in 1905 was more than a half million barrels in excess of that of the previous year.

Following is a table designed to show the growth and development of the Portland-cement industry in this country since 1890. Under the heading of "Section" are the names of the two counties in Pennsylvania which include nearly all the great cement works in the heart of this industry, the names of several of the States that are large or old producers, and the remaining cement-producing States, namely, Alabama, California, Colorado, Georgia, Illinois, Indiana, Kansas, Kentucky, Missouri, South Dakota, Texas, Utah, Virginia, and West Virginia, and such other counties in Pennsylvania as have cement plants outside of Northampton and Lehigh counties.

The tables for 1890 and 1900 include Warren County, N. J., with the two above mentioned counties in Pennsylvania, and, as the New Jersey county is a part of what has for many years been known as the Lehigh district, this was a proper inclusion at that time. But in 1903 the State totals showing production of Portland had become so large that it was thought best to make a separation of the three counties in accordance with the States to which they belong. This course has been followed in the succeeding tables as well.

Development of the Portland-cement industry in the United States since 1890.

[Barrels.]

Section.	1890.			1900.		
	Number of works.	Quantity.	Percentage.	Number of works.	Quantity.	Percentage.
New York	4	65,000	19.4	8	465,832	5.5
Lehigh and Northampton counties, Pa., and Warren County, N. J	5	201,000	59.9	15	6,153,629	72.6
Ohio	2	22,000	6.5	6	534,215	6.3
Michigan	....	....	....	6	664,750	7.8
All other sections	5	47,500	14.2	15	663,594	7.8
Total	16	335,500	100.0	50	8,482,020	100.0

Section.	1904.			1905.		
	Number of works.	Quantity.	Percentage.	Number of works.	Quantity.	Percentage.
New York	11	1,362,514	5.1	11	2,111,411	6.0
Lehigh and Northampton counties, Pa	15	11,411,620	43.1	15	13,713,910	38.9
New Jersey	3	2,799,419	10.6	3	3,654,777	10.4
Ohio	7	910,297	3.4	8	1,312,977	3.7
Michigan	16	2,247,160	8.5	16	2,773,283	7.9
All other sections	29	7,774,871	29.3	36	11,680,454	33.1
Total	81	26,505,881	100.0	89	35,246,812	100.0

THE PORTLAND-CEMENT INDUSTRY, BY STATES.

Alabama.—The production of the single factory which manufactured Portland cement in Alabama during 1905 was larger than that of the preceding year by more than a third of the entire quantity, notwithstanding the fact that the mill was closed down about three months for improvements and repairs. The plant for manufacturing Portland cement that is to be built at Epes, having offices at Selma, is still in embryo, the company not yet having begun construction. The deposit of limestone to be utilized by this company is practically the same as that at Demopolis, where Portland cement has been successfully made since 1902. The Standard Portland Cement Company, of Charleston, S. C., has purchased property at Leeds, on the Southern Railway, 17 miles from Birmingham, and will begin erection of a Portland cement mill there immediately. The company owns about 300 acres of land bearing limestone of the Trenton formation. The plant will be completed in 1906.

Arkansas.—This State has but one cement plant, that at White Cliffs, which was closed during 1905, and has gone into the hands of a receiver.

California.—There is a great and constant demand for cement on the western coast, and California is rapidly growing in ability to supply it. In 1905 the three plants already established in the State were active and produced an output which was in advance of that for the preceding year. One of these plants was somewhat hampered by a shortage of water power, which necessitated several weeks of idleness, and another was closed down a short time for repairs; but the year's work averaged well. The erection of a large plant in southern California, at Davenport, near Santa Cruz, is the outcome of the demand for American cement in California and the Far West. The new organization is the Santa Cruz Portland Cement Company, and several of its officers are also officers and stockholders in the Standard Portland Cement Company, whose plant is at Napa Junction. The new factory will be operative early in 1906. It will have 12 kilns, each 125 feet by 8 feet. The mill site is near the ocean, and a pier will be built in order that shipments of cement may be made by water as well as by rail. The tract of land owned by the company at this point contains more than 200 acres of limestone, and the deposit runs to 500 feet in height. There are also about 300 acres of shale in the holdings. In this plant oil will be used for fuel, and power will be brought from the Sierra Nevada Mountains.

Colorado.—There was but one cement plant active in Colorado in 1905, and its output was about a third larger than that made during the preceding year. Two additional rotary kilns, 8 feet in diameter by 125 in length, are now being installed. When this is completed, the plant will have a capacity of 2,200 barrels of cement per day. The alterations and improvements are now in progress, and the company expects to complete them entirely and to put the new kilns in operation by early fall in 1906. One other company incorporated for the manufacture of Portland cement is reported from this State, but as yet it has not erected a plant. The offices are located in Denver.

Georgia.—The one Portland-cement plant in Georgia was active during the entire year in 1905. About the same quantity of cement was made as formed the output for the preceding year, but owing to the prevalence of better prices in 1905 it was worth almost half again as much as that made in 1904.

Illinois.—With the exception of an advance in the production of each of the Portland-cement-producing factories over their output for the previous year, there was little difference in the record of Illinois for 1904 and 1905. Of the four active Portland plants, one was idle two months for repairs, one ran on full time, and one was closed for three months while improvements, additional machinery, and repairs were put in. The fourth company, which makes slag as well as Portland cement, ran its factory for the production of Portland cement through the entire year and had an output in advance of that for the preceding year.

The Illinois Steel Company will turn over the management of its cement plants to the Universal Portland Cement Company, a constituent company of the United States Steel Corporation, which will continue the business formerly handled by the cement department of the Illinois Steel Company. Mr. Hagar, former manager of this department, will be president of the new company. The new plants at Buffington, Ind., and at North Bessemer, Pa., which will also be included in the new company, will be completed in the summer of 1907. When they are active, the entire capacity of the Universal Portland Cement Company will be 16,000 barrels of Portland cement per day.

A Portland-cement company, having its home offices in Ohio, states that it is beginning the construction of a factory at Dixon, Ill.; that the new mill will use limestone and clay as its materials, and will have a capacity of 2,000 barrels of cement per day; and that the plant will be operated at least in part by water power.

Indiana.—The Portland-cement produced in this State in 1905 was made by five plants, two of which were mentioned in the report for 1904 as about to be put into active operation. The Buffington plant, built by the Illinois Steel Company, of Chicago, had its initial run in 1905. A new plant having a capacity of 6,000 barrels of Portland cement per day, located on land adjoining that of the operative cement plant, is now being built by the Illinois Steel Company at Buffington. The present plant has a capacity of 5,000 barrels per day. The mills were continuously active throughout the year. The factory at Bedford was started early in the year, and had a very successful run. These mills had an exceedingly satisfactory beginning. The plant at Mitchell ran on full time the entire year and produced an output which was in excess of its yield for the preceding year by more than a half million barrels. The two other factories which produced Portland cement in this State during the year are located in the northeastern part of the State, and have had successful productions since they first became active. The output of each for 1905 was considerably in advance of that for the previous year. One ran on full time all the year, and the other was only closed down a short time for necessary repairs. The increased demand for Portland cement has caused a decline of such proportions in the production of natural cement in this country that some of the companies that have heretofore had plants equipped solely for making natural cement are turning their attention to the manufacture of Portland. In some instances there is preparation to add the machinery necessary for the latter production and to continue the former as well, while in others the producing of natural cement will be entirely abandoned, and the buildings will be utilized for the installation of machinery for the making of Portland cement only. In the Rosendale, Cumberland, and Louisville districts such changes are being made. Indiana inaugurates the erection of a new Portland plant adjoining the old natural plant, in the Louisville district, at Speeds. The Speed Portland mills are the first to be erected here, and the success of the factory will mark many changes. Two kilns, 100 by 7 feet, each having a capacity of 350 barrels of cement per day, have been set up. There are also the usual crushers, driers, tube mills, and kominuters, and in the coal plant there is a Cummer drier, with Smidth ball and tube mills. Power is furnished by a 900-horsepower, Hamilton cross-compound Corliss engine, which drives the raw grinding machinery, the kilns, and the clinker mills. The preliminary crusher and pan-mill, as well as the coal grinder, are driven by a separate 150-horsepower engine. Although the plant as it now stands is not an exceedingly large one, it has been planned and built with a view to readily increasing its capacity, if the results justify such extension. The buildings and all foundations laid to carry heavy machinery are constructed of solid concrete made with natural cement from the plant adjoining. None of the other projects for the erection of Portland-cement plants in this State reported in the preceding year have taken an active shape in 1905. One plant, which was nearly completed in 1904, is still unfinished, and no work is now being done on it. There is a new plant being erected at Kimmel, in the northern part of the State, on which work is being rapidly pushed. It will be completed during the summer of 1906, and when ready to be started up will have two kilns 100 feet long and 7 feet in diameter installed. Marl and clay will be the raw materials used. The holdings of the company at present include a number of lakes and marshes extending over about 700 acres. The purpose of this company is to attempt the production of a white Portland cement to be used in art construction. The name adopted, the Art Portland Cement Company, is indicative of this purpose. The new company has no connection with a company of similar name which was in existence a few years ago in Ohio, but which went out of business in 1900.

Kansas.—The growth of the Portland-cement industry in Kansas has been very marked within the last five years. Up to 1900, when the Iola plant made its first production, only natural cement plants existed in the State. In 1904 the Kansas Portland Cement Company began operations, and in 1905 two new plants were started late in the fall and winter. The new plant at Neodesha consists of a 40 by 56 by 30 foot crusher building; a drying and mixing building 106 by 47 by 42 feet; a raw grinding building 146 by 80 by 25 feet, which is equipped with ball and tube mills; a finished grinding building 96 by 96 by 25 feet, in which are more ball and tube mills; a kiln building 162 by 96 by 25 feet, wherein 6 rotaries 70 by 7 feet are installed; a boiler building 80 by 40 feet; an engine building 100 by 50 feet, in which are two Corliss engines; an electric lighting engine with generator attached, and two friction clutches, which will carry either half of the mill separately; storehouses 124 by 50 feet and 120 by 65 feet, besides storerooms, office buildings, motor and fan buildings, blacksmith shop, powder magazine, and a building for exploder, cap, and fuse—all made of steel construction covered with gavanized iron. The stone is conveyed from the quarries to the plant on two overhead tramways and tracks, approximately 100 feet long. The capacity of the mill is about 2,000 barrels of cement per day.

The new plant at Independence, which was put into operation late in the fall of the year, used all of its six large rotaries for a short but very satisfactory run during the remainder of the year.

There is a new plant reported to be in process of construction at Table Mound, near Independence. Natural gas is the fuel used in all the Kansas plants.

Kentucky.—The new plant for the manufacture of Portland cement, which was completed and made its initial production in this State late in 1905, started out very successfully. This factory is the first one ever erected in Kentucky for the production of Portland cement.

There is a plan reported which projects the erection of a Portland-cement plant near Staunton, Ky., where a large deposit of suitable rock is said to have been found.

Michigan.—Portland cement in 1905 was made by 13 plants, as in 1904. Of these plants nearly all were idle through some part of the year, which possibly accounts for the fact that the increase in total production for the State over its output for the preceding year is but little more than a half million barrels. Two plants were idle to admit of enlargements and one was closed down while the 60-foot kilns already installed were removed in order that new kilns 100 feet long might replace them. Another plant was so thoroughly reconstructed that half the year was taken up with the improvements, and the mill was not started until late in July. Two plants were closed for a time because of the weather; one by reason of a full stock house; two for minor repairs, and one company went into the hands of a receiver. The new plant at Bellevue was started in September and was successfully operated the rest of the year. In addition to the 13 active plants, there were two that were idle all the year, two that were not under construction at any time, although when work was stopped on them both were more than half completed, and one that was so nearly finished it will be ready to become active early in 1906. One company was dissolved and its holdings sold; three were reported as being still "incomplete," and four plants projected at different places were recorded as still only projects. The cement mill at Hecla, after standing idle for nearly three years, has been purchased and will be reopened, overhauled, and operated again in 1906. All told, there were 25 companies reporting from this State for 1905.

Missouri.—There were two active Portland-cement plants in Missouri in 1905; both of them were very successful producers and made outputs which in each case ran far ahead of that manufactured during the previous year. The plant at Louisiana was not completed, but will probably become active in 1906. There is also a new factory, located just outside of Kansas City, Mo. It was practically ready to commence operations at the close of the year and will be a producer in 1906. The present capacity of this plant is about 1,000 barrels per day, and it was constructed with a view to enlarging. Up to the early winter of 1902, when the plant at St. Louis made a comparatively small output of Portland, no cement of any kind had been produced in Missouri. The plant at Hannibal had its first production in 1903.

New Jersey.—In this State the entire production of Portland cement, which is second only to that of Pennsylvania in quantity, is manufactured by three plants. All three of the plants ran continuously through 1905, and each one manufactured a quantity of cement largely in advance of its production for the preceding year. The most marked advance in quantity was made by the factory at Stewartsville. In 1905 this plant had its most successful production, and the year was unmarked by any serious disaster at the mills.

New York.—In 1905 there were nine cement plants in New York that made Portland cement, and of these but one had also a production of natural cement. Another plant was being altered so as to admit of a production of a high-grade Portland especially adapted for use in the manufacture of artificial stone, in connection with its production of natural cement. One plant was sold, but not operated in 1905. Of the eight factories that produced only Portland cement, seven ran ahead of their 1904 output, some by a large percentage and some by a smaller. One mill made more than five times as much as it produced the year before; one made about three times as much, and two more than doubled the quantity. All of these plants were shut down from periods varying from ten days to three months, either by reason of slight overproduction or on account of bad weather or for repairs. The land on which the Wayland Portland-cement plant was built has been sold since the burning of the factory in December, 1904. The natural-cement plant at Jamesville has been purchased by a company owning and successfully operating cement mills in another county of New York State, and it is its present intention to build eventually a large factory on the Jamesville place for the purpose of manufacturing Portland cement.

Ohio.—There were eight factories producing Portland cement in this State in 1905, and the total output ran ahead of the production for the preceding year by more than a quarter of a million barrels. Three of the plants were idle but a few weeks; two were idle about a third of the year for repairs and improvements; one was idle two months while alterations were being made; one was shut down for a short period because of high water, and one was inoperative half the year while new engines were being put in place. One plant, which has been idle for several years, was sold and may become a producer of Portland cement again in 1906. In spite of the idleness of the plants the total State production of Portland ran ahead of the million-barrel mark for the first time in its history.

Pennsylvania.—This State, which has always been the center of the Portland-cement industry in the United States, had a large output in 1905, as the result of eighteen active cement plants. One new factory was not started until late in the summer, but it finished the year with a remarkably large output for the initial run. Several of the mills were shut down a few weeks for repairs and one plant suffered from a scarcity of water. Another of the larger factories was idle several months making alterations; but the majority of the plants report a record of full time for the entire year. The general prosperity of the Portland-cement industry in this country was indicated in this great center, for the entire State production ran up to nearly 14,000,000 barrels, while prior to 1905 its largest output was less than eleven and a half million barrels. There are several plants which are expected to become active in 1906. Several new companies have been organized, and one, which is backed by California capital, has purchased land and is ready to begin erecting a factory.

The Universal Portland Cement Company, which will take over all the cement plants of the Illinois Steel Company, will build a plant for the manufacture of Portland cement at North Bessemer, near Pittsburg. Work on this plant will begin at once. The material used will be slag from the works of the Carnegie Steel Company, and limestone. The plant will have a capacity of 4,000 barrels per day, and will be known as the Carnegie Cement Plant.

South Dakota.—There is but one Portland-cement plant in this State. In 1905 the mill was continuously active. The installation of new machinery and the remodeling of the plant that was successfully accomplished during the preceding year was apparent in the quantity of cement produced this year, as it was increased to more than four times the amount of any output heretofore reported from this mill. The project for a second plant in South Dakota has not yet advanced to the erection of a mill, though it is reported as by no means abandoned.

Texas.—There are three Portland-cement plants in Texas, one of which has also an equipment for producing natural cement. In 1905 this factory and the remodeled plant at Dallas produced all the cement made in the State, the Austin plant remaining idle throughout the year. Of the two active plants, one ran continuously through the year and produced an output which was considerably in advance of that made in 1904, and the other was shut down for a couple of months, during which time the machinery was repaired and some alterations were made. Notwithstanding this lapse the output from the mill was many thousands of barrels in advance of that produced during the previous year.

Utah.—In 1905 the single Portland-cement plant in Utah had its largest production, the figures reported for the year showing a decided advance over those giving the production for 1904. The plant was active during the year except a brief stoppage for overhauling. There are two new projects reported from this State for the building of Portland-cement plants during the coming year. One plant is to be erected by the Rocky Mountain Portland Cement Company, near Salt Lake City, and the other is to be located at a town that was formerly called Croydon, on the Union Pacific Railway, 28 miles east of Ogden. The name of this town has recently been changed to Portland, because of the decision of the Union Pacific Portland Cement Company to locate its new plant there. The three rotary kilns to be installed are 8 feet in diameter by 150 feet in length, and are the largest boiler-plate kilns in the world. The kilns at the Edison factory in New Jersey are of equal size, but are made of cast iron. The tube mills in the new Utah plant are also of a much larger size than usual. Powdered coal will be the fuel used in the rotaries, and the output from the three kilns is expected to be 2,000 barrels of cement per day. A modern electric plant is part of the equipment of the plant, as is a steam shovel, with which all the raw material will be handled. The company owns over 2,000 acres of land. The plant is expected to be ready for operation early in 1907.

Virginia.—The single Portland-cement factory in Virginia has always been a successful one. Its first output was made in 1900, and since that time the number of barrels of cement produced has been increased each year, so that the record shows a marked and steady advance. In 1905 it ran ahead of its production for the previous year, as usual, and was only idle two weeks for repairs. The mill has nearly a 2,000-barrel capacity. There is a plant projected in this State by one of the successful companies now producing cement in the Lehigh district, but no buildings are yet erected.

Washington.—The Portland-cement plant for this State, which has been projected for several years, is now an accomplished fact. It was practically completed in 1905, and will be put into operation during the first half of 1906. As soon as this is accomplished, the plant will at once put in more rotaries and increase its producing capacity. For its initial run two 100-foot rotary kilns have been installed, and those to be added will be equally large. The entire plant has been built with a view to a gradual increase in size until the full capacity of power is utilized, at which time the production of Portland cement will have reached 3,000 barrels per day. Power is furnished by water brought from Baker River, across which a dam has been built. A flume 6 by 10 feet, and 14,700 feet in length, conducts the water to the factory. Crude oil will furnish fuel for the rotaries and driers, and limestone and shale will be the materials used for making cement. The factory is built at the junction of the Skagit and Baker rivers, 45 miles east of Anacortes, and is within 1,500 feet of the lime quarry and 300 feet of the shale beds, both of which materials are brought to the mills by means of electric motors. The Great Northern Railway runs through the factory site, thus insuring shipping facilities. The ample opportunity for cement plants in the Northwest was shown during the last year by the shortage in Portland cement, which was so great that coast contractors were obliged to send as far east as Kansas for enough cement to finish buildings already started. There is a plan reported for the building of a cement plant on one of the islands north and west of Washington and included in the State lines.

West Virginia.—As in 1904, there was but one active Portland-cement-producing plant in this State in 1905. This factory was idle several months, repairing and remodeling. There is to be a new plant built at Martinsburg which will have a daily capacity of 2,000 barrels of Portland cement, but it will not be completed before the end of 1906.

NATURAL CEMENT.

The decrease in the natural-cement industry continued in 1905, and the total production fell below that of the preceding year, as it has done for several years. Many plants in the natural cement manufacturing districts were not put into operation during the year, and some were started up simply to make a small quantity of cement for use by the owners of the plant. Several natural-cement mills have been torn down and the land on which they stood sold for other purposes, and a few have been made into lime kilns. There was but one new plant built during the year for an exclusive production of natural cement. The decline in this industry seems to be permanent.

PRODUCTION.

In 1905 the total production of natural cement in the United States amounted to 4,473,-049 barrels, having a value of $2,413,052. This decrease of 393,282 barrels, as compared with the production of 1904, is not so large as the decrease shown in a comparison of the product of natural cement in 1904 with that manufactured in 1903. The demand, however, seems to be mostly for Portland cement, and reports from the various manufacturers of the natural product show little indication of any strong revival of a demand for this variety of cement, though the falling off in quantity seems to be checked a little.

Following is a table showing the quantity and value of the natural cement made in the United States in 1903, 1904, and 1905.

Production of natural cement in 1903, 1904, and 1905, by States.

[Barrels.]

State.	1903.			1904.			1905.		
	Number of works.	Quantity.	Value.	Number of works.	Quantity.	Value.	Number of works.	Quantity.	Value.
Georgia	2	80,620	$44,402	2	66,500	$37,750	3	89,167	$51,040
Illinois	3	543,132	178,900	3	360,308	113,000	3	368,645	116,549
Indiana				13	735,906	367,953	12	527,600	211,040
Kansas	2	226,293	169,155	2	210,922	79,456	2	230,686	110,750
Kentucky	15	1,533,573	766,786	2	264,104	132,052	2	207,500	83,000
Maryland	4	269,957	138,619	4	65,000	32,500	4	55,324	28,694
Minnesota	2	175,000	78,750	2	138,000	65,620	2	115,314	57,643
Nebraska				1			1		
New York	20	2,417,137	1,510,529	19	1,911,402	1,138,667	16	1,926,837	1,332,809
North Dakota	1			1			1		
Ohio	2	67,025	46,776	1			1	64,791	51,235
Pennsylvania	7	1,339,090	576,269	5	770,897	298,533	5	748,057	306,555
Texas	2			1			1		
Virginia	2	47,922	25,961	2	93,292	59,619	2		
West Virginia	1			1			1		
Wisconsin	2	330,522	139,373	2	250,000	125,000	2	139,128	63,737
Total	65	[a]7,030,271	3,675,520	61	[a]4,866,331	2,450,150	58	[b]4,473,049	2,413,052

[a] The States combined for 1903 and 1904 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 1905 are given in the text below.

In making these combinations, which are necessary in order to avoid disclosing individual productions, the same States have been grouped together for 1905 that were combined in 1904. North Dakota, which has but one plant, has been recorded in combination with Minnesota, Ohio with Virginia, and Texas with Kansas. As before, the totals are placed against the name of the State contributing the largest quantity to the whole amount.

New York stands at the head of the natural-cement production, as always, and again is the only State to exceed a million barrels of this cement in its production.

THE NATURAL-CEMENT INDUSTRY, BY STATES.

In all the States given below there are cement plants erected for the purpose of producing natural cement, but in 1905 only a certain percentage of these plants were operative. Where a factory has been reported as having no prospect of again engaging in the business of producing this variety of cement, it has been dropped from the number of works given in the tables; but where it is reported simply as idle, and there are chances that it will become productive again, it is retained in the count. Thus, in Ohio there are in reality two plants which are well equipped for the production of natural cement. But in one case there is no immediate prospect that the plant will be active again. In consequence, Ohio has but one plant reported for this production. In Nebraska, on the contrary, although the single plant there is a natural-cement plant which has been inoperative for some years, there is no talk of abandoning the mill, and it may become active again at any time. Therefore it is included in the number of plants given.

Following are detailed accounts of State productions:

Florida.—The report from Florida for 1905 is very definite, and states that there is now no plant for the manufacture of cement at River Junction and that none will be erected there for a production of natural cement. If the large deposit of limestone which occurs there is utilized for producing cement, a factory will be erected for the purpose of manufacturing Portland cement.

Georgia.—This State is distinctive in that it is the only one from which a new plant for the production of natural cement is reported in 1905. The new factory was started in September and ran satisfactorily during the remainder of the year. The two older factories were both active the entire year, except for a month's idleness in one for necessary repairs. In the other plant the full number of kilns was not fired because of a scarcity of labor. The total production of natural cement in the State, however, was noticeably larger than that for the preceding year.

Illinois.—The production of natural cement in Illinois in 1905 exceeded the output for 1904 slightly, though two of the three manufacturing factories ran behind their productions for the previous year. The third plant more than doubled its output, however, which increased the total production sufficiently to more than balance the shortage. One of three plants ran throughout the year, another was idle three months making repairs, and the third ran on less than full time.

Indiana.—The record of this State for 1905 is comparatively small. There were 12 mills equipped for manufacture, but most of them were idle. Many of the companies report inactivity because of a lack of orders, and several of them are considering a radical change in their equipment. One of the factories located at Charlestown has already been sold to a western company, and will be overhauled and remodeled in such a way as to admit of the manufacture of Portland cement. The materials for such a production are abundant on this property, and the rebuilding will be started in 1906. The quantity of natural cement manufactured in the Louisville district in 1905 was not so far below that for the preceding year as might have been expected, but the sales were not very ready, and at the close of the year there were more than 100,000 barrels of cement left unsold in the stock houses.

Kansas.—In this State the production of natural cement, which has for many years been successfully carried on, ran ahead of that for the preceding year. The older of the two plants which manufactured natural cement had an output considerably larger than that reported for 1904 and ran throughout the year. The other plant was idle during a part of the year, the production being not quite equal in size to the one recorded in 1905.

Kentucky.—Both the natural-cement plants in Kentucky were active in 1905, though neither of them ran continuously through the year. Much of the cement credited to the Louisville district is made by these mills for the smaller plants, and they are both well equipped and well located for the work. Their output in 1905 was somewhat smaller than that for the previous year.

Maryland.—Of the four mills that have for years reported a production of natural cement from this State, but two were active in 1905, and they had comparatively small outputs. The lack of demand for natural cement was felt in the Cumberland district as in other centers for the natural-cement production. One of the active plants in Maryland ran only a few months and the other ran but little more than half the year. Of the two idle plants, one is closed down permanently and the report of the other shows that the company is engaged in erecting a Portland-cement plant, but that it is not yet completed. Another of the natural-cement plants may also be converted into a factory for the production of Portland cement, as the materials on the property owned by the company are adapted to such a project. The plan is under consideration, but has not yet been definitely decided on.

Minnesota.—In this State the record for 1905 is practically a duplicate of that for the previous year. There were two plants producing natural cement; both were closed down for a part of the year; one mill ran ahead of its output for 1904 and the other fell slightly behind. The lack of orders for the natural product was not so sharply felt in this section of the country as it was in the eastern States, where cement plants are not so scattered.

Nebraska.—There has never been but one cement plant in this State, and that has produced only cement of the natural variety. In 1905 the mill was idle, and it has been so for several years past. There is a prospect that the mill will be active again, but the time of firing the kilns is not stated.

New York.—The production of natural cement was larger in the Rosendale district in 1905 than it was in 1904, notwithstanding the depressed conditions in that branch of the cement industry. Seven of the plants that make natural cement were inactive in 1905, but a number of the producing factories had outputs which were in advance of those made in the previous year. One plant was idle practically all the year undergoing extensive alterations, but will probably be active in 1906. The consolidation of a number of natural cement producing companies, which occurred several years ago in the Rosendale district still holds, and the combined companies reported a production decidedly in advance of their output in 1904. One of the old, well-established plants was idle because of the death of the owner, and it is doubtful if the kilns will be used again for making cement. There are no new plants for the production of natural cement reported from New York in 1905.

North Dakota.—The change of stockholders made in 1905 in the plant which produces the only cement made in North Dakota caused several months' idleness in the works during the fall of the year. The season through which cement can be profitably made in this climate is not so long as it is in warmer places, and owing to this and the inactivity mentioned the production of cement in this State was not so large as that for the year preceding. Large improvements and the installation of new machinery are being talked of for this plant, which has a large field in which to exploit its production, however ample.

Ohio.—Although there are two plants in this State that are equipped for manufacturing natural cement, but one of them was a producer in 1905, and it ran ahead of its output for 1904. This plant has steadily increased its production each year and usually is run continuously throughout the season. Such was its record for 1905. The other plant, which has been closed for several years, may be dismantled or may stand idle for many years.

Pennsylvania.—There are no cement plants used exclusively for producing natural cement in Pennsylvania. All such cement is manufactured by factories also engaged in making Portland cement. In 1905 four of these plants were actively producing natural cement, and the fifth one, that has the machinery to admit of such a production, stood idle. Of the four active mills, three had outputs of natural cement that were smaller than those made in 1904, while the other factory increased its output. All the mills ran practically on full time through the year, the only stoppages occurring in order that small but necessary repairs might be made. The total State production of natural cement was not so large as that for the previous year.

Texas.—The only plant which produces natural cement in Texas was active in 1905 and ran continuously through the year. It produced an output considerably in excess of that made in the preceding year, but not so large as that made in 1903. This plant has been a successful one for years, and has no record of any long period of inactivity since it was built. There is another plant in the State which was formerly devoted exclusively to the manufacture of natural cement, but it has not been operated for several years. The third cement factory in Texas was remodeled and made into a Portland-cement plant two years ago, since which time it has produced that article.

Virginia.—There were two active natural-cement plants in the State of Virginia in 1905. Of these two, one had a production slightly in advance of that made the previous year, and the other manufactured less than a fifth of the quantity made in 1904, being active only about two months. Both plants suffered from the fact that orders were lacking, and give the usual report that the demand was mostly for Portland cement.

West Virginia.—The natural-cement industry in West Virginia was not a thriving one in 1905. The plants in the State that usually produce this variety of cement were idle all the year, and one of them was offered for sale.

Wisconsin.—The two plants operating in this State in 1905 produced only natural cement and were active during the season. One of them produced an output in advance of that made the previous year, and the other ran very far behind the quantity made in 1904. The total cement production of the State is less than the total production of a year before, the failing demand for natural cement having caused a lack of orders here, as in many other States.

PUZZOLAN OR SLAG CEMENT.

The growth in the slag-cement industry is slow, but the number of plants for producing it gradually increases. In 1905 Kentucky was added to the list of slag-cement-producing States, and the erection of a large plant at Buffalo will add still another State to that list in 1906. The new plant is located on the property of the Union Furnace Company, and will be built by the same people who designed and erected the new slag-cement plant at Ashland, Ky.

PRODUCTION.

As in previous years only two States had more than one slag-cement plant in 1905. For that reason it is impossible to classify each State and give a table of production in detail. In the combinations made for the purpose of concealing individual figures of production Alabama and Illinois totals are added and the result is placed against Illinois, as this State reported the larger production; and Maryland, Pennsylvania, Ohio, New Jersey, and Kentucky totals are given together with the resulting product placed against Ohio for a like reason.

Following is a table showing the total production of puzzolan or slag cement in the United States in 1905, together with the number of plants:

Production of slag cement in the United States in 1904 and 1905 by States.

[Barrels.]

State.	1904.			1905.		
	Number of works.	Quantity.	Value.	Number of works.	Quantity.	Value.
Alabama	2	187,677	$141,402	2		
Illinois	1			1	106,236	$80,616
Kentucky				1		
Maryland	1			1		
New Jersey	1			1		
Ohio	2	115,368	85,249	2	276,211	191,998
Pennsylvania	1			1		
Total	8	303,045	226,651	9	382,447	272,614

THE PUZZOLAN-CEMENT INDUSTRY, BY STATES.

Accounts in detail of each State which contributed to the entire quantity of slag cement made in the United States in 1905 are as follows:

Alabama.—The conditions prevailing in the State of Alabama in 1905 were nearly the same as those that obtained in 1904. There were two plants actively engaged in producing puzzolan cement. These two plants are owned by different companies, but one company leases the plant of the other and has operated both factories for several years. The output of cement was not so large as that for the preceding year and the plants were closed for a part of the season.

Illinois.—There is but one puzzolan-cement factory in this State, and it is operated by the Illinois Steel Company. In 1905 the plant at North Chicago was active in producing a quantity of slag cement intended solely for use by the company in its construction work. For certain parts of the work it has found puzzolan cement entirely satisfactory. It has, however, abandoned the production of this cement for commercial purposes and reports that if there was no construction work being done by the company there would be no slag cement made by it and the mill at North Chicago would be dismantled or fitted for use in manufacturing Portland cement only. The slag cement plant was active only a part of the time, and its production was somewhat less than that made in 1904.

Kentucky.—Late in 1905 the only slag-cement mill in the State was finished and became active, reporting a small production. This plant is built at Ashland, Ky., by the Ashland Iron and Mining Company and is claimed to be the finest slag-cement plant in the country. The buildings are of concrete-block construction, with all the foundations both for machinery and buildings made from a slag cement—sand-crushed-cinder concrete. The mill has a capacity of 550 barrels per day, and the stock house is provided with bins capable of holding 15,000 barrels of cement. The cement is ground to such a degree of fineness that 95 per cent of it will pass through a 200-mesh screen. There are three Ruggles Coles driers 30 feet long by 5 feet 10 inches in diameter, and four tube mills 22 feet long by 5 feet in diameter. Fuel for the driers is furnished from the collieries owned and operated by the company, and blast-furnace gas is used to generate steam for power. The pit for granulating the hot slag is made of slag cement and crushed-cinder concrete and is 21 feet wide, 40 feet long, and 25 feet deep. There are chemical and physical laboratories, both of which are well equipped with the most modern apparatus for cement testing. A characteristic chemical analysis of the Ashland puzzolan cement is as follows:

Analysis of puzzolan cement from Kentucky.

Silica	35.72
Iron oxide	.84
Alumina	9.72
Lime	45.42
Magnesia	2.85
Sulphur	1.42
Loss on ignition	3.66
Undetermined	.37
	100.00

Maryland.—There is but one company in this State which produces puzzolan cement and its plant was idle nearly half the year in 1905. The output of the factory was larger than that for 1904, but fell short of its averages for five years prior to that time.

New Jersey.—Only one plant in this State produced slag cement in 1905, and it was active during only a part of the year. The demand for this kind of cement was not large enough to make greater activity necessary in this section of the country. The production was smaller than that reported in 1903. In 1904 the mills were closed down and the site of the factory was changed.

Ohio.—The year of 1905 was a prosperous one for the slag-cement industry in Ohio. This State has two plants producing puzzolan cement and both were active, though neither ran continuously through the year. The older plant closed down for a short time, because of a lack of orders, but even so it almost doubled its output for the year previous. The newer mill was obliged to close down for necessary repairs and some small remodeling of part of the plant, but it made an output which more than doubled its production for 1904, which was a large one.

Pennsylvania.—The single puzzolan-cement factory in the State of Pennsylvania reported its third and largest production in 1905. The company did not operate these mills continuously, because of the cold weather, but the entire output for the year was nearly twice as large as that for 1904.

KILN REPORT FOR 1905.

The latest report on the approximate number and variety of kilns in the cement plants of the United States made by this Bureau was in 1902.

At that time the number reported was much smaller than it now is, though the increase in the use of the rotary kiln was then strongly marked. At the present time nearly all the Portland cement in this country is burned in rotary kilns, there being in 1905 only three factories reporting productions of Portland cement burned in vertical kilns.

The increase in the establishment of rotaries within the last three years is shown approximately in the following table.

Number, kind, and condition of kilns in 1902 and 1905.

Kind.	1902.			1905.		
	Active.	Idle.	Building.	Active.	Idle.	Building.
Vertical	611	76	6	395	116	....
Rotary	456	9	46	722	23	42
Total	1,067	85	52	1,117	139	42

IMPORTS AND EXPORTS.

IMPORTS.

The total quantity of hydraulic cement brought into the United States from foreign countries in 1905 was 846,577 barrels. The total quantity withdrawn for consumption was 896,845 barrels. For the first time in the history of cement in this country the quantity of cement imported from foreign countries is smaller than the quantity withdrawn from warehouse during the year for consumption, the difference being 50,268 barrels.

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 1902–1905, by countries.

[Barrels.]

Country.	1902.	1903.	1904.	1905.
United Kingdom	79,087	146,994	16,365	33,978
Belgium	615,794	737,576	394,368	335,154
France	14,922	14,866	34,912	18,864
Germany	1,259,265	1,377,414	585,563	456,325
Other European countries	18,654	27,415	7,538	602
British North America	3,612	4,421	566	417
Other countries	4,154	9,265	7,091	1,237
Total	1,995,488	2,317,951	1,046,403	846,577

RELATION OF DOMESTIC PRODUCTION AND CONSUMPTION TO IMPORTS.

In the following table is shown the increase, by years, in the production of Portland cement in the United States, the increase and decrease of the natural cement, and the variations in imports for consumption of hydraulic cements into this country, since 1900:

Comparison of production of Portland and natural-rock cement in the United States with imports for consumption of hydraulic cement, 1900–1905.

[Barrels.]

Year.	Natural cement.	Portland cement.	Total of natural and Portland cement.	Imports.
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
1905	4,473,049	35,246,812	39,719,861	896,845

This table does not include the production of puzzolan cement, which has been recorded in this Bureau since 1901, and is as follows: 1901, 272,689 barrels; 1902, 478,555 barrels; 1903, 525,896 barrels; 1904, 303,045 barrels; and 1905, 382,447 barrels.

Figures showing the imports and exports of cement to and from this country have never been divided into detailed statements as to Portland, natural, or puzzolan cement. They are received at the Bureau of Statistics as "hydraulic cements," undivided into classes, and are thus forwarded to this Bureau. Therefore the comparison in the following table can not be made between domestic Portland and imported Portland, but must be made between domestic Portland and all imported hydraulic cements. The table shows a comparative statement of the production of Portland cement in the United States and of the entire quantity of hydraulic cement imported into and consumed in the United States in 1891, 1901, 1904, and 1905:

Comparison of domestic production of Portland cement with consumption of Portland and all imported hydraulic cements, 1891, 1901, 1904, and 1905.

[Barrels.]

	1891.	1901.	1904.	1905.
Production of Portland in the United States	454,813	12,711,225	26,505,881	35,246,812
Imports (entered for consumption)	2,988,313	922,426	968,409	896,845
Total	3,443,126	13,633,651	27,474,290	36,143,657
Exports (domestic)	....	417,625	774,940	897,686
Consumption	3,443,126	13,216,026	26,699,350	35,245,971
Percentage of production of Portland to consumption in the United States	13.2	96.2	99.2	100

For the first time the percentage of production of Portland cement to consumption of Portland and of imported cement in the United States exceeds 100. The increase of exports and the decrease of imports is very clearly marked in 1905.

EXPORTS.

In 1905 the quantity of domestic cement sent out of this country amounted to about nine-tenths of a million barrels, which is the first time exports have reached such a mark. The shortage in cement from which some sections of the country suffered, the ever increasing uses to which cement is put, and the state of foreign markets did not suffice to check the growth in the exporting of American cement. This is a field which has not heretofore been sufficiently exploited, and the figures for 1905 show a most encouraging change.

The total quantity of hydraulic cement, both domestic and foreign, sent out of the country in 1905 was 897,686 barrels. Following is a table showing exports of domestic hydraulic cement since 1900:

Exports of domestic hydraulic cement, 1900–1905.

[Barrels.]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1900	100,400	$225,306	1903	285,463	$433,984
1901	373,934	679,296	1904	774,940	1,104,086
1902	340,821	526,471	1905	897,686	1,387,906

The total apparent consumption of all hydraulic cement in the United States in 1905 amounted to 40,101,467 barrels.

Fig. 1 is a graphic illustration designed to show the growth of the production and of the apparent consumption of hydraulic cement in the United States, and the decline of the imports of foreign hydraulic cements, since 1890. The diagram includes all hydraulic

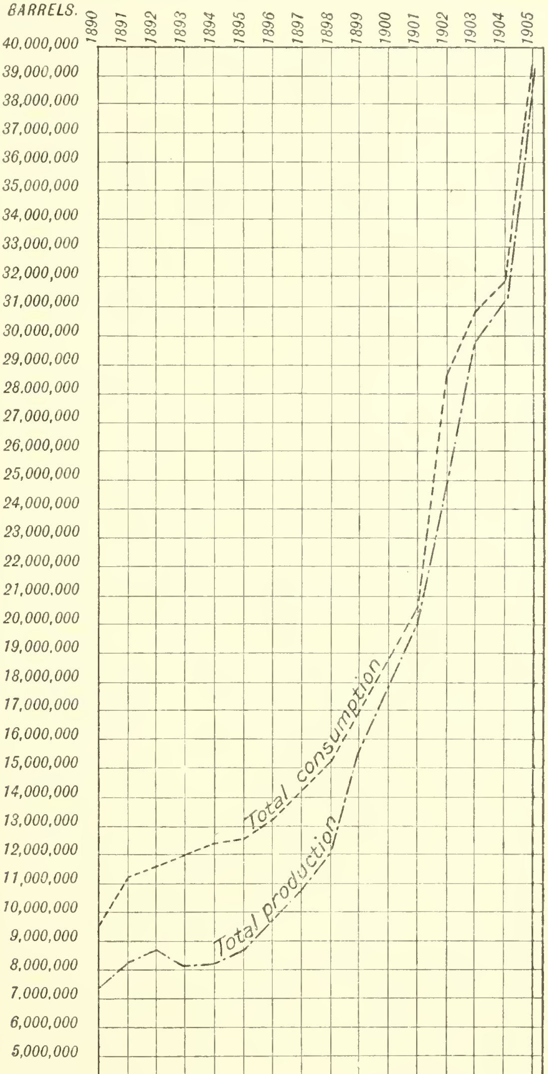

Fig. 1.—Diagram showing growth of the production and of the apparent consumption of hydraulic cement in the United States, and decline of the imports of foreign hydraulic cements, since 1890.

cement, so far as the figures are recorded in this Bureau. Prior to 1900 a record of production of slag cement was not kept, and therefore slag cement is not included in the total production previous to that year.

CEMENT IN FOREIGN COUNTRIES.

Canada.—An increased production of Portland cement and a decreased production of natural cement are shown in the records of Canada for 1905. The Geological Survey of Canada[a] reports that the production of natural-rock cement, which in 1904 had decreased to 56,814 barrels (of 350 pounds), valued at $50,247, fell off in 1905 to the comparatively small amount of 14,184 barrels, valued at $10,274. This was made by three firms in Ontario.

The production of Portland cement, however, continues to increase steadily. Thirteen companies were operating plants during 1905, with a total daily capacity of about 8,000 barrels—viz, one in Nova Scotia, 2 in Quebec, 9 in Ontario, and one in British Columbia, while another in Ontario was engaged in reconstruction work. The average price per barrel at the works in 1905 was $1.42, being only a fraction of a cent higher than the average price in 1904. The imports of Portland cement into Canada in 1905 were 718,275 barrels (of 350 pounds), valued at $912,209. The duty is 12½ cents per 100 pounds.

As there is very little cement exported from Canada, the consumption of the product in 1905 would be approximately 1,346,548 barrels of home product and 718,275 barrels of imported, or a total of 2,064,823 barrels.

The figures given, showing the total production of cement in Canada in 1905, are 1,360,731 barrels, having a value of $1,924,014. Of this amount, 1,346,547 barrels were Portland, valued at $1,913,740, and 14,184 barrels were natural, valued at $10,274. This total production is given as 2.81 per cent of the value of the entire mineral production in Canada in 1905.

The records from Manitoba show that more than half the cement consumed there in 1905 was from the United States, and that at least one importer of American cement was unable to obtain as much as he wanted during the year. An unusually large amount of building will be done in this district in 1906, and this, with the construction of the Grand Trunk Pacific Railroad and the extension of some other lines, will increase the demand for Portland cement.[b]

Mexico.—In the building up of an export trade for American cements Mexico should be considered, according to Consul Canada, of Veracruz.[b] A great deal of cement is used in Mexico, but the United States does not supply much of it. Mexico has been making extraordinary efforts to provide safe harbors, to improve her light-houses, to construct new and to improve old railroads, and to do many other things which require a great deal of cement, and it is apparent that that country offers a splendid field for American manufacturers of cement.

Belgium has a tight hold on the Mexican market, the greater part of all the cement consumed at the present time coming from that country. Germany is making strenuous efforts to get a foothold. German cement may be bought in Mexico for $4.50 per barrel of 396 pounds, equivalent to $2.25 United States currency. From this the price rises to $6.75 per barrel according to brand ($3.38 United States). The import duty on cement is 55 cents per 100 kilograms gross weight, equivalent to 27½ cents United States per 220 pounds gross weight. There are minor expenses connected with this which will bring the cost a little higher. Freight from Antwerp or Hamburg to Veracruz per cargo lots may be quoted as from 12 to 15 shillings per 2,204 pounds, to which must be added 5 per cent on the total. The packages are similar to those in the United States. Near the City of Mexico two cement works are in operation, which have all they can do to furnish cement for contractors of paving and other public works in that city. Competition in the cement market is so strong that sales are made on a margin of 12½ cents United States currency.[b]

Bermuda.—Bermuda appears to be another market which might easily be made available for exports of American cements. Vice-consul Heyl, of Hamilton, Bermuda, reports[b] that up to 1904 British Portland cement constituted nearly all the cement imported into that colony, but that in 1905 a few hundred barrels of American cement were imported, with the

[a] Summary of the mineral production of Canada for 1905, Geol. Survey Canada, 1906.
[b] Daily Cons. Repts. No. 2527, April 2, 1906.

result that American cement has been found equal to the best English brands and has been sold at 12 cents per barrel less than the English product. The dealers in English cement have heretofore been able to secure cheaper freight rates, owing to the competition of the steamship lines, but as one of these has withdrawn, the freight rate has advanced from 10s. to 22s. ($2.44 to $5.25) per ton. This new British evidence as to the quality of American cement should have the effect of breaking down the prejudice which exists in favor of British cements—in far-off British possessions especially—for its supposed superior quality.

France.—The conditions existing in France, as a possible market for American cement, appear to be rather discouraging.

Consul-General Skinner,[a] of Marseille, replying to a request for "as complete information as possible regarding the cement industry and markets for cement in various countries," suggests that any contemplated effort to obtain a foothold for American cement in France had better be devoted at the present time to an effort to sell cement in those remote markets to which large quantities of French cement are now being exported. The French exports of cement during 1905 amounted to 277,530 tons.

Although France imported 20,450 tons of cement in 1905, these figures offer little encouragement to American exporters, since the importations consisted almost exclusively of Belgian cement, produced near the French frontier and shipped in bulk at a minimum of expense. There is, moreover, a discriminating duty of 25 centimes ($0.048) per 100 kilos (220 pounds) against American cement, which would be obliged to pay the maximum rate of duty. This maximum tariff is 75 centimes (14.47 cents) per 220 pounds for slow-setting cement and 50 centimes (9.65 cents) per 220 pounds for rapid-setting cement.

French cement is shipped to domestic purchasers and even to foreign buyers who are able to secure prompt deliveries in jute bags. In the case of domestic transactions the cost of the package is not included, and the bags, which are worth about 19 cents each, are returned to the manufacturers. Cement for exportation is almost invariably forwarded in cheap barrels, and the prices quoted to buyers include the cost thereof. The cost of French cement of the best grade approximates $6.95 per 2,200 pounds at the factory. For the export trade competition is keen and prices vary somewhat.

The world's production of Portland cement in 1904 is thus reported by the Marseille Chamber of Commerce: United States, 3,000,000 tons; Germany, 2,500,000 tons; England, 1,500,000 tons; Belgium, 685,000 tons; France, 555,000 tons; Russia, 500,000 tons; miscellaneous, 500,000 tons.

Belgium.—Consul-General Roosevelt sends from Brussels an interesting statement concerning the cement industry of Belgium, and in regard to the reported combination of Belgian, Dutch, and German cement works to regulate production and prices for a term of nine years. He says: As concerns the inquiry relative to a reported combine I am informed by one of the most important of the cement dealers in Brussels that sometime ago an agreement was entered into between a German syndicate and twelve Belgian cement works to the following effect: The German syndicate agreed not to sell its cement in Belgium, and the twelve Belgian cement works pledged themselves not to sell their product in Germany; and to prevent competition the German syndicate is to confine its sales in Holland to towns lying near the German frontier and reached at a less cost than could be reached by the Belgian adherents, and vice versa as concerns town in Holland nearer to the Belgian frontier and more advantageously accessible to the Belgians.

There are 35 cement works in Belgium producing an annual output of about 1,000,000 tons. This output is pretty equally divided between consumption and the export trade. The total quantity of cement imported into Belgium during the year 1904 was 82,704,123 pounds, valued at $174,130. Over 72,000,000 pounds came from Germany and over 8,000,000 from France, the remaining quantity came from Holland, Luxemburg, and other countries.

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[a]Daily Cons. Repts. No. 2527, April 2, 1906.

The total quantity of cement exported from Belgium during 1904 was 1,294,248,365 pounds, valued at $27,259,810. Of that quantity England took 508,000,000 pounds, the United States 146,000,000 pounds, Holland 128,000,000 pounds, Argentina 84,000,000 pounds, and Brazil 71,000,000 pounds. In less important quantities cement was sent to Canada and other countries.

The present selling price of cement, according to quality, is from 84 cents to $1.04 per barrel of 396 pounds, gross weight, cost of barrel included, freight on board Antwerp. The price of Portland cement for home consumption is from $3.66 to $3.86 at works per 1,000 kilos. Cotton sacks and paper bags are not used for cement in Belgium. Barrels and canvas sacks only are employed. The works repurchase the sacks, but not the barrels, allowing from 3 to 9 cents per sack, according to size.

American cement, says Consul-General Roosevelt, could be sold in Belgium provided it was introduced in such manner as to attract attention and win confidence by its quality and price.[a]

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[a] Daily Cons. Repts. No. 2527, April 2, 1906.

CLAY-WORKING INDUSTRIES.

By Jefferson Middleton.

INTRODUCTION.

With the exception of the section on clay production, this report deals with the products of the clay-working industries, and hence the tables are made up to show the products of clay and not the production of clay.

That the clay-working industries of the United States have shared in the general great prosperity of the country is abundantly shown in the following pages, the activity of the year 1905 being a sort of reaction from the previous year. Although the year 1904 was one of general prosperity, the clay-working industries were just about able to hold their own; but the year 1905 was one of unusual progress, with a resulting great increase in the value of the clay products marketed.

The building industries were in a state of great activity in 1905, and as the larger part of clay products is used as structural materials; this industry naturally kept pace with the building industry, and in spite of the high prices of labor and materials, the highest in many years, the building operations were the most extensive ever known.

Another cause for the extension of the clay-working industry is the scarcity and consequent high price of timber as a building material, the time having arrived when, in many places, even at the present high cost of clay products, it has become about as cheap to construct a dwelling of brick as of timber, and the time is not far distant when not only city houses, but country and village houses as well, will be constructed of clay or some other form of mineral product.

The advent of sand-lime brick, cement blocks, and concrete construction—while these may and undoubtedly do supplant to some extent the clay product—does not seem up to the present time to have materially interfered with the splendid progress of the clay-working industry, there apparently being room enough for all.

Prosperous as was the year 1905, the year 1906 gives every indication of being even more prosperous in the building and clay-working industries, and of showing the largest value for clay products as yet recorded, though from its very nature the industry will continue to increase in importance in the United States with its vast deposits of clay.

There has been no marked improvement in processes or machinery during the year, though the inventors of systems of handling brick and of drying them have been developing their properties, and the introduction of improved machinery into the smaller plants continues. The graduates of the ceramic schools also are being placed in positions where they will have an influence on the quality of the ware produced, and will thus tend to make the United States independent of foreign countries in the production of high-grade ceramic wares.

The value of the clay products, as shown in the appended tables, increased from $131,023,248 in 1904 to $149,697,188 in 1905, a gain of $18,673,940, or 14.25 per cent. In 1904 there was a decrease of $39,173, or 0.03 per cent, and in 1903 there was an increase over 1902 of $8,892,890, or 7.28 per cent.

The labor situation in the building trades in 1905 was fairly good, no great strike being inaugurated, though there was more or less disturbance by reason of strikes in other trades, notably the teamsters' strike in Chicago.

The average prices obtained for brick, the only item on which an average price can be given, were considerably higher than in 1904. The average price for common brick for the whole country was $6.25 per thousand as against $5.97 per thousand in 1904 and 1903. The great consumption of building brick by Greater New York, the principal portion of which was supplied by the Hudson River region, was the most striking feature of the year in the common-brick industry. Prices rose to $10 per thousand for this class of brick at New York, whereas only a few years ago the same brick sold for $5 per thousand or less.

The only important branch of the clay-working industry to show a decline in 1905 was paving brick. For some reason the value of this product declined from $7,557,425 in 1904 to $6,703,710, a loss of $853,715, or 11.30 per cent. The prospects are, however, that in 1906 paving brick will recover its lost ground and show a larger product than ever before. The average value of this product declined from $10.28 per thousand in 1904 to $10.07 in 1905.

The number of operating firms reporting declined from 6,108 in 1904 to 5,925 in 1905. The great prosperity of the year has attracted many new producers who had no output in 1905, but will be producers in 1906. The number of operating firms reporting should not be taken to be the same as the number of plants, since many firms operate 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, which showed a decrease of $277,782 in 1904, rallied in 1905, and not only overcame this loss, but showed a gain over 1904 of $2,760,624, or 10.97 per cent.

ACKNOWLEDGMENTS.

As in previous years, the writer, on behalf of the office, desires to thank the clay workers of the country for their cooperation, without which this report would have been impossible. Thanks are also extended to the officials in the cities who have supplied the information concerning the building operations of the principal cities of the country.

The writer is also indebted to Miss Belle Worth Bagley and Miss Martha B. Clark, of the United States Geological Survey, not only for the accuracy of the tables of this report, but also for their fidelity and interest in the work.

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. For 1905, in addition to the foregoing, the State geological survey of Illinois cooperated in that State with most satisfactory results.

BUILDING OPERATIONS.

The following table shows the number of building permits and the value of the buildings erected under these permits in the leading cities of the country in 1904 and 1905, the increase or decrease in the value of the buildings erected in each city in 1905, and the total increase, together with the percentage of increase or decrease in each case and the percentage of total increase.

Building operations in the leading cities of the United States in 1904 and 1905.

City.	1904.		1905.		Gain or loss in 1905.	Percentage gain or loss in 1905.
	Number of permits.	Cost of buildings.	Number of permits.	Cost of buildings.		
Allegheny, Pa	828	$2,219,096	816	$2,412,570	+ $193,474	+ 8.72
Atlanta, Ga	3,542	4,213,446	3,499	3,312,931	− 900,515	− 21.37
Baltimore, Md	2,046	5,842,559	2,976	16,638,200	+ 10,795,641	+184.78
Boston, Mass	2,779	22,028,067	2,249	12,364,747	− 9,663,320	− 43.87
Brooklyn, N. Y	8,913	46,627,687	19,679	73,017,706	+ 26,390,019	+ 56.60
Buffalo, N. Y	2,677	6,638,319	2,886	7,401,006	+ 762,687	+ 11.49
Cambridge, Mass	473	1,964,020	470	1,659,875	− 304,145	− 15.49
Chicago, Ill	7,151	44,735,058	16,150	65,000,000	+ 20,264,942	+ 45.30
Cincinnati, Ohio	2,952	6,308,895	3,307	9,709,450	+ 3,400,555	+ 53.90
Cleveland, Ohio	3,911	6,562,590	4,976	9,777,145	+ 3,214,555	+ 48.98
Columbus, Ohio	1,652	3,785,335	2,133	5,107,400	+ 1,322,065	+ 34.93
Dayton, Ohio	1,283	2,380,000	1,176	2,350,000	− 30,000	− 1.26
Denver, Colo	2,081	4,091,668	2,455	6,374,537	+ 2,282,869	+ 55.79
Detroit, Mich	3,552	6,737,105	4,021	10,462,100	+ 3,724,995	+ 55.29
Fall River, Mass	314	769,450	291	885,625	+ 116,175	+ 15.10
Grand Rapids, Mich	1,328	1,635,624	1,486	2,145,265	+ 509,641	+ 31.16
Hartford, Conn	511	2,144,605	664	3,076,092	+ 931,487	+ 43.43
Indianapolis, Ind	3,238	4,072,136	4,041	7,225,325	+ 3,153,189	+ 77.43
Jersey City, N. J	1,118	3,523,780	1,352	3,330,522	− 193,258	− 5.48
Kansas City, Kans	643	1,022,891	818	1,172,093	+ 149,202	+ 14.59
Kansas City, Mo	4,351	8,816,757	4,437	10,917,024	+ 2,100,267	+ 23.82
Los Angeles, Cal	7,090	13,409,062	9,543	15,382,057	+ 1,972,995	+ 14.71
Louisville, Ky	1,904	2,313,596	2,255	4,506,382	+ 2,192,786	+ 94.78
Memphis, Tenn	2,813	2,264,880	2,882	3,554,883	+ 1,290,003	+ 56.96
Milwaukee, Wis	3,546	8,131,765	4,166	9,806,729	+ 1,674,964	+ 20.60
Minneapolis, Minn	4,466	6,701,965	4,825	8,905,205	+ 2,203,240	+ 32.87
Nashville, Tenn	5,849	1,450,422	5,636	2,609,889	+ 1,159,467	+ 79.94
Newark, N. J	2,182	6,304,947	2,379	10,214,615	+ 3,909,668	+ 62.01
New Haven, Conn	404	1,909,460	467	2,143,240	+ 233,780	+ 12.24
New Orleans, La	1,798	2,964,154	1,970	4,070,077	+ 1,105,923	+ 37.31
New York, N. Y	6,149	108,318,458	10,043	178,032,527	+ 69,714,069	+ 64.36
Omaha, Nebr	789	2,051,930	885	4,387,464	+ 2,335,534	+113.82
Philadelphia, Pa	8,398	28,967,760	15,933	34,416,745	+ 5,448,985	+ 18.81
Pittsburg, Pa	3,857	17,502,680	4,273	17,159,443	− 343,237	− 1.96
Providence, R. I	1,206	3,454,800	1,358	4,562,950	+ 1,108,150	+ 32.08
Reading, Pa	1,229	1,633,175	1,548	2,791,065	+ 1,157,890	+ 70.90
Richmond, Va	462	2,378,681	451	1,501,000	− 877,681	− 36.90
Rochester, N. Y	1,050	4,225,927	1,707	5,676,624	+ 1,450,697	+ 34.33
St. Joseph, Mo	985	688,027	877	670,195	− 17,832	− 2.59
St. Louis, Mo	5,960	14,075,794	8,285	23,434,734	+ 9,358,940	+ 66.49
St. Paul, Minn	2,675	7,033,110	1,657	8,536,345	+ 1,503,235	+ 21.37
San Francisco, Cal	5,060	17,494,948	5,420	18,268,753	+ 773,805	+ 4.42
Scranton, Pa	977	1,850,267	1,144	2,212,929	+ 362,662	+ 19.60
Seattle, Wash	7,436	7,801,120	7,677	6,704,784	− 1,096,336	− 14.05
Syracuse, N. Y	734	2,739,827	837	2,275,610	− 464,217	− 16.94
Toledo, Ohio	1,091	1,960,297	1,169	6,004,633	+ 4,044,336	+206.31
Washington, D. C	6,384	13,042,491	7,577	12,308,943	− 733,548	− 5.62
Worcester, Mass	627	1,871,376	739	2,182,840	+ 311,464	+ 16.64
Total	140,464	468,660,007	185,585	646,660,274	+178,000,267	+ 37.98

From this table it will be seen that in the 48 cities represented the number of permits issued increased from 140,464 in 1904 to 185,585 in 1905, a gain of 45,121 permits, or 32.12 per cent, while the value of the buildings erected under these permits increased $178,000,267, or 37.98 per cent, thus indicating that the buildings erected in 1905 were slightly more costly than in 1904.

Of these cities, 11 showed a decrease in the value of the buildings erected, namely: Atlanta, Boston, Cambridge, Dayton, Jersey City, Pittsburg, Richmond, St. Joseph, Seattle, Syracuse, and Washington. These decreases range from $17,832 in St. Joseph to $9,663,320 in Boston. The causes of these decreases vary in different cities, in some the high price and scarcity of building material being given as the reason, though the general reason appears to be the fact that in 1904 permits were taken out for a few large buildings, such as railway stations, large apartments, etc., so that in the most cases these losses are more apparent than real.

The city showing the largest actual increase was New York, though the city showing the largest proportional increase was Toledo, where the percentage was 206.31, the actual increase being $4,044,336, as against New York's increase of $69,714,069, with a percentage of increase of only 64.36. Toledo's large increase in 1905 is due to the construction of large and unusually expensive buildings.

Baltimore showed the next largest proportional increase—184.78—its actual increase being $10,795,641, the natural result of the great fire in that city in 1904. In Greater New York the value of the buildings increased from $154,946,145 in 1904 to $251,050,233 in 1905, an increase of $96,104,088, or 62.02 per cent. Omaha, Nebr.; Louisville, Ky.; Nashville, Tenn.; Indianapolis, Ind.; Reading, Pa., and St. Louis, Mo., also show large increases. The latter, especially, is interesting, in view of the fact that 1905 was the year following an international exposition. The conditions presented in St. Louis are unique in that in the year following the exposition the value of the buildings erected increased $9,358,940 over the exposition year, and this city rose in relative rank from eighth in 1904 to fifth in 1905.

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, $3,337 in 1904, and $3,484 in 1905. The average value per permit in 1905 in the leading cities was: New York, $17,727; Brooklyn, $3,710; Chicago, $4,025; Philadelphia, $2,160; St. Louis, $2,829; San Francisco, $3,371; Pittsburg, $4,016; Baltimore, $5,591; Los Angeles, $1,612, and Boston, $5,498.

The rank of the several cities varies but little. In the first ten cities in 1905 St. Louis rose from eighth to fifth place, San Francisco from seventh to sixth, Baltimore from twenty-first to eighth, and Pittsburg and Washington each fell one place.

PRODUCTION.

In the following table will be found statements of the values of the clay products in 1904 and 1905:

Value of the products of clay in the United States in 1904 and 1905, by States and Territories.

States and Territories.	1905.			1904.		
	Brick and tile.	Pottery.	Total.	Brick and tile.	Pottery.	Total.
Alabama	$1,358,626	$34,245	$1,392,871	$1,257,015	$32,533	$1,289,548
Arizona	90,436	....	90,436	68,885	....	68,885
Arkansas	623,871	20,088	643,959	675,332	21,250	696,582
California	3,769,934	95,213	3,865,147	3,553,016	71,718	3,624,734
Colorado	1,548,236	48,995	1,633,231	1,153,921	35,370	1,189,291
Connecticut and Rhode Island	1,503,478	a 105,100	1,608,578	1,146,034	a 69,575	1,215,609
Delaware	227,064	....	227,064	158,970	....	158,970
District of Columbia	307,109	9,912	317,021	296,443	10,017	306,460
Florida	329,738	(b)	329,738	252,864	....	252,864
Georgia	2,097,356	22,390	2,119,746	1,898,879	22,057	1,920,936
Idaho and Nevada	230,780	....	230,780	199,417	....	199,417
Illinois	11,418,779	943,007	12,361,786	9,947,751	829,696	10,777,447
Indiana	5,567,426	932,147	6,499,573	5,198,898	703,691	5,902,589
Indian Territory	374,235	....	374,235	268,926	....	268,926
Iowa	3,321,763	70,359	3,392,122	3,392,719	68,134	3,460,853
Kansas	1,906,360	(b)	1,906,360	1,843,630	(b)	1,843,630
Kentucky	2,249,267	157,083	2,406,350	1,929,664	157,613	2,087,277
Louisiana	821,109	(b)	821,109	1,009,274	2,204	1,011,478
Maine	619,294	(b)	619,294	558,361	(b)	558,361
Maryland	1,885,009	364,358	2,249,367	1,469,126	402,931	1,872,057
Massachusetts	1,751,616	298,841	2,050,457	1,440,743	288,315	1,729,058
Michigan	1,719,746	45,961	1,765,707	1,670,892	43,621	1,714,513
Minnesota	1,499,386	(b)	1,499,386	1,319,907	(b)	1,319,907
Mississippi	803,317	15,580	818,897	760,793	14,701	775,494
Missouri	6,160,043	43,368	6,203,411	5,410,686	70,818	5,481,504
Montana	313,006	(b)	313,006	279,431	(b)	279,431
Nebraska	1,006,743	....	1,006,743	1,067,387	....	1,067,387
New Hampshire	554,734	(b)	554,734	479,985	(b)	479,985
New Jersey	10,044,191	6,655,334	16,699,525	7,354,294	5,949,753	13,304,047
New Mexico	141,722	....	141,722	108,764	....	108,764
New York	12,858,617	1,627,730	14,486,347	9,228,432	1,314,638	10,543,070
North Carolina	1,006,842	13,319	1,020,161	883,964	14,000	897,964
North Dakota	232,432	....	232,432	147,579	....	147,579
Ohio	15,278,968	13,024,071	28,303,039	13,978,485	11,669,298	25,647,783
Oklahoma	222,064	....	222,064	262,098	....	262,098
Oregon	380,575	(b)	380,575	446,340	(b)	446,340
Pennsylvania	17,778,122	1,346,431	19,124,553	15,421,981	1,399,882	16,821,863
South Carolina	720,997	28,838	749,835	716,458	15,575	732,033
South Dakota	58,271	....	58,271	63,203	....	63,203
Tennessee	1,329,609	163,670	1,493,279	1,284,201	151,584	1,435,785
Texas	1,618,157	100,788	1,718,945	1,429,596	106,501	1,536,097
Utah	544,578	(b)	544,578	419,726	(b)	419,726
Vermont	112,967	....	112,967	100,153	(b)	100,153
Virginia	1,994,578	(b)	1,994,578	1,708,728	27,664	1,736,392
Washington	1,133,932	41,100	1,175,032	1,178,919	22,000	1,200,919
West Virginia	822,990	1,195,805	2,018,795	1,009,344	1,065,205	2,074,549
Wisconsin	1,369,665	12,450	1,382,115	1,377,919	13,075	1,390,994
Wyoming	34,556	....	34,556	35,845	....	35,845
Other States	....	c 502,711	c 502,711	....	c 564,851	c 564,851
Total	121,778,294	27,918,894	149,697,188	105,864,978	25,158,270	131,023,248
Per cent of total	81.35	18.65	100.00	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 individual figures.

This table shows that the marketed clay products of the United States were valued at $149,697,188 in 1905 as compared with $131,023,248 in 1904, a gain of $18,673,940, or 14.25 per cent. Next to 1899, when the gain over 1898 was $21,309,690, or 28.61 per cent, the increase in 1905 over 1904 was the largest recorded since this office began the publication of the statistics of the clay-working industries.

Of the total for 1905, the materials which enter into the structural and engineering arts—the brick and tile of this classification—were valued at $121,778,294, or 81.35 per cent, while the pottery, or finer grade of goods, was valued at $27,918,894, or 18.65 per cent. In 1904 these figures were, respectively, $105,864,978, or 80.80 per cent, and $25,158,270, or 19.20 per cent, a slight gain in the coarser products in 1905, though these relative proportions have been practically maintained for quite a number of years.

Value of the clay products of the United States, by States, in 1904 and 1905, showing increase or decrease with percentage of increase or decrease.

State.	1905.	1904.	Increase (+) and decrease (−) in 1905.	Per cent of increase (+) and decrease (−) in 1905.
Alabama	$1,392,871	$1,289,548	+ $103,323	+ 8.01
Arizona	90,436	68,885	+ 21,551	+31.29
Arkansas	643,959	696,582	− 52,623	− 7.55
California	3,865,147	3,624,734	+ 240,413	+ 6.63
Colorado	1,633,231	1,189,291	+ 443,940	+37.33
Connecticut and Rhode Island	1,608,578	1,215,609	+ 392,969	+32.33
Delaware	227,064	158,970	+ 68,094	+42.83
District of Columbia	317,021	306,460	+ 10,561	+34.42
Florida	329,738	252,864	+ 76,874	+30.40
Georgia	2,119,746	1,920,936	+ 198,810	+10.35
Idaho and Nevada	230,780	199,417	+ 31,363	+15.73
Illinois	12,361,786	10,777,447	+ 1,584,339	+14.70
Indiana	6,499,573	5,902,589	+ 596,984	+10.11
Indian Territory	374,235	268,926	+ 105,309	+39.16
Iowa	3,392,122	3,460,853	− 68,731	− 1.99
Kansas	1,906,360	1,843,630	+ 62,730	+ 3.40
Kentucky	2,406,350	2,087,277	+ 319,073	+15.29
Louisiana	821,109	1,011,478	− 190,369	−18.82
Maine	619,294	558,361	+ 60,933	+10.91
Maryland	2,249,367	1,872,057	+ 377,310	+20.15
Massachusetts	2,050,457	1,729,058	+ 321,399	+18.59
Michigan	1,765,707	1,714,513	+ 51,194	+ 2.99
Minnesota	1,499,386	1,319,907	+ 179,479	+13.60
Mississippi	818,897	775,494	+ 43,403	+ 5.60
Missouri	6,203,411	5,481,504	+ 721,907	+13.17
Montana	313,006	279,431	+ 33,575	+12.02
Nebraska	1,006,743	1,067,387	− 60,644	− 5.68
New Hampshire	554,734	479,985	+ 74,749	+15.57
New Jersey	16,699,525	13,304,047	+ 3,395,478	+25.52
New Mexico	141,722	108,764	+ 32,958	+30.30
New York	14,486,347	10,543,070	+ 3,943,277	+37.40
North Carolina	1,020,161	897,964	+ 122,197	+13.61
North Dakota	232,432	147,579	+ 84,853	+57.50
Ohio	28,303,039	25,647,783	+ 2,655,256	+10.35
Oklahoma	222,064	262,098	− 40,034	−15.27
Oregon	380,575	446,340	− 65,765	−14.73
Pennsylvania	19,124,553	16,821,863	+ 2,302,690	+13.69
South Carolina	749,835	732,033	+ 17,802	+ 2.43
South Dakota	58,271	63,203	− 4,932	− 7.80
Tennessee	1,493,279	1,435,785	+ 57,494	+ 4.00
Texas	1,718,945	1,536,097	+ 182,848	+11.90
Utah	544,578	419,726	+ 124,852	+29.75
Vermont	112,967	100,153	+ 12,814	+12.79
Virginia	1,994,578	1,736,392	+ 258,186	+14.87
Washington	1,175,032	1,200,919	− 25,887	− 2.16
West Virginia	2,018,795	2,074,549	− 55,754	− 2.69
Wisconsin	1,382,115	1,390,994	− 8,879	− .64
Wyoming	34,556	35,845	− 1,289	− 3.60
Other States	[a] 502,711	[a] 564,851	− 62,140	−11.00
Total	149,697,188	131,023,248	+18,673,940	+14.25

[a] Includes pottery products which could not be separately classified without disclosing individual figures.

This table shows that every State and Territory in the Union is a producer of clay products, though Rhode Island and Nevada have not a sufficient number of producers to publish their figures alone without disclosing individual returns.

Of the States and Territories represented by the 48 totals, 37 show gains, and 11 losses in 1905 as compared with 1904. In 1904, 23 States showed decreases. The States showing losses in 1905 are Arkansas, Iowa, Louisiana, Nebraska, Oklahoma, Oregon, South Dakota, Washington, West Virginia, Wisconsin, and Wyoming. The losses are all comparatively small, ranging from $190,369 in Louisiana to $1,289 in Wyoming. The total of these losses was $5,574,907.

Of the States that showed gains New York was first; New Jersey was next; Ohio, the leading State in the value of clay products, was third; Pennsylvania was fourth; Illinois, another of the leading States, was fifth; and Missouri, sixth. Other States showed gains, in the following order: Indiana, Colorado, Connecticut and Rhode Island, Maryland, Massachusetts, Kentucky, Virginia. The remainder of the States showed small increases in value of products. Of the States that showed decreases in 1904, Colorado, Delaware, Illinois, Kentucky, Maine, Maryland, Massachusetts, Minnesota, Missouri, Montana, New Hampshire, New Jersey, New Mexico, Pennsylvania, Utah, and Vermont show large gains in 1905, some even passing their records for 1903. Of the 23 States reporting losses in 1904, all but three report gains in 1905. The three reporting losses in both years are Oklahoma, South Dakota, and West Virginia. While New York shows the largest actual gain, $3,943,277, or 37.40 per cent, over 1904, some of the smaller producing States made larger proportional gains, North Dakota increasing 57.50 per cent, Delaware 42.83 per cent, and Indian Territory 39.16 per cent.

In the following table will be found a comparison of the several varieties of clay products marketed in 1904 and 1905, 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 1904 and 1905, with increase or decrease.

Product.	1904.	1905.	Increase in 1905.	Percentage of increase in 1905.
Common brick	$51,768,558	$61,394,383	$9,625,825	18.59
Vitrified paving brick or block	7,557,425	6,703,710	[a] 853,715	[a] 11.30
Front brick	5,560,131	7,108,092	1,547,961	27.84
Fancy or ornamental brick	300,233	293,907	[a] 6,326	[a] 2.11
Enameled brick	545,397	636,279	90,882	16.66
Fire brick	[b] 11,167,972	[b] 12,735,404	1,567,432	14.04
Drain tile	5,348,555	5,850,210	501,655	9.38
Sewer pipe	9,187,423	10,097,089	909,666	9.90
Architectural terra cotta	4,107,473	5,003,158	895,685	21.81
Fireproofing, hollow building tile or blocks, and terra-cotta lumber	3,629,101	4,098,793	469,692	12.94
Tile (not drain)	3,023,428	3,647,726	624,298	20.65
Miscellaneous	3,669,282	4,209,543	540,261	14.72
Total brick and tile	105,864,978	121,778,294	15,913,316	15.03
Total pottery	25,158,270	27,918,894	2,760,624	10.97
Grand total	131,023,248	149,697,188	18,673,940	14.25

[a] Decrease. [b] Stove lining included in miscellaneous.

This table shows in a most striking manner the lines of activity. It will be observed that only two varieties of wares showed a small decrease, namely, the vitrified paving brick products and the fancy or ornamental brick product, while every other brick and tile product and the pottery industry also showed increases, some of them quite large gains, the largest being in the products used as structural materials, and especially in those materials entering into the construction of fine buildings, such as front brick, architectural terra cotta, structural tile (including roofing, wall, and floor tile), enameled brick and fireproofing.

The largest actual gain, as has been the case for many years, was in the common brick industry, which showed an increase of $9,625,825 as compared with a gain of $1,236,483 in 1904, although the proportional gain—18.59 per cent—was not the largest. The proportional gain of common brick in 1904 was 2.45 per cent.

The vitrified paving brick industry is the only one of importance that showed a decrease. This product declined from $7,557,425 in 1904 to $6,703,710 in 1905, a loss of $853,715, or 11.30 per cent. This loss is one of the most astonishing features brought out by the canvass, as this product has been increasing in popularity, as shown by its enlarging sales. The only explanation of this decrease seems to be that the demand for common brick was so great that either paving brick were used and reported as common brick, or the makers of paving brick became makers of common building brick. In 1904 the paving-brick product increased $1,103,576, or 17.10 per cent. The value of the product in 1905 was, notwithstanding the decrease, greater than in 1903 by $249,861, or 3.87 per cent.

The front-brick product showed the largest proportional increase in 1905, being 27.84 per cent, the value being $7,108,092 in 1905 as compared with $5,560,131 in 1904, a gain of $1,547,961. In 1904 front brick increased in value $157,270, or 2.91 per cent. Not only does this product show the largest proportional increase, but in actual increase it is exceeded only by common brick and fire brick. This great increase is probably due to the erection of a larger number of fine structures, such as apartments and office buildings, which require large quantities of front or face brick. Since this brick stands transportation to points at considerable distances from its place of production, the point of consumption can not be determined by the State from which it is reported.

The fancy or ornamental brick product, never of very great importance, continues to decline, falling from $300,233 in 1904 to $293,907 in 1905, a decrease of 2.11 per cent. This product is probably being displaced by terra cotta. In 1904 the decline was $28,154, or 8.57 per cent.

Enameled brick, which showed a decrease of $24,292, or 4.26 per cent, in 1904, showed a comparatively large gain in 1905, increasing $90,882, or 16.66 per cent, as foreshadowed in the 1904 report. This product is apt to increase in the near future by reason of the demand created by large building operations in the Eastern States.

The fire-brick industry, always of great importance, showed a large gain in 1905, rallying from a big loss in 1904 in consonance with the fall and rise in the iron and steel industry. The increase in 1905 was $1,567,432, or 14.04 per cent, as compared with a decrease in value in 1904 of $2,894,397, or 20.58 per cent. In 1905, however, this product did not reach the maximum reported for 1903, namely, $14,062,369, though it should be stated that the figures for 1903 include stove lining, the value of which is not known, though it was probably about the same as in 1902—$630,924.

Drain tile increased $501,655, or 9.38 per cent, and sewer pipe increased $909,666, or 9.90 per cent.

Architectural terra cotta is another of the materials entering into the construction of fine buildings which shows a large increase in 1905 over 1904, the value of this product rising from $4,107,473 to $5,003,158, a gain of $895,685, or 21.81 per cent. This product showed a decrease in 1904.

Fireproofing, which is used only in the larger buildings, not only recovered from a loss reported in 1904, but passed the 1903 production of $3,861,343 by $237,450, making the total for 1905 $4,098,793, a gain over 1904 of $469,692, or 12.94 per cent. The use of this product will probably continue to increase, as recent large fires and earthquakes have demonstrated its superiority as a fireproofing and structural material.

The materials embraced under the head of tile (not drain) include roofing, wall, floor, and encaustic tile, all materials used only in the better class of buildings. As all other materials used in this class of structures showed large increases, these materials also increased from $3,023,428 in 1904 to $3,647,726 in 1905, a gain of $624,298, or 20.65 per cent, exceeding the maximum of $3,622,863 in 1902 by $24,863.

The products embraced in the miscellaneous column vary so much from year to year that a comparison is meaningless.

The following table shows the products of clay in the United States from 1894 to 1905, 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, 1894–1905, by varieties.

Year.	Number of operating firms reporting.	Common brick.			Front brick.		
		Quantity.	Value.	Average price per thousand.	Quantity.	Value.	Average price per thousand.
		Thousands.			*Thousands.*		
1894	....	6,152,420	$35,062,538	$5.70	(a)	(a)	....
1895	....	6,017,965	31,569,126	5.25	339,204	$4,399,367	$12.97
1896	5,293	5,703,279	29,664,043	5.20	270,335	3,390,941	12.54
1897	5,424	5,292,532	26,430,207	4.99	310,918	3,855,033	12.40
1898	5,971	5,867,415	30,980,704	5.28	295,833	3,572,385	12.08
1899	6,962	7,695,305	39,887,522	5.18	438,817	4,767,343	10.86
1900	6,475	7,140,622	38,621,514	5.41	344,516	3,864,670	11.09
1901	6,421	8,038,579	45,503,076	5.66	415,343	4,709,737	11.34
1902	6,046	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	6,108	8,665,171	51,768,558	5.97	434,351	5,560,131	12.80
1905	5,925	9,817,355	61,394,383	6.25	541,590	7,108,092	13.12

Year.	Vitrified paving brick.			Fancy or ornamental brick (value).	Enameled brick (value).	Fire brick (value).	Stove lining (value).	Drain tile (value).
	Quantity.	Value.	Average price per thousand.					
	Thousands.							
1894	457,021	$3,711,073	$8.12	$1,128,608	(b)	$4,762,820	(c)	$5,803,168
1895	381,591	3,130,472	8.20	652,519	(b)	5,279,004	(c)	3,450,961
1896	320,407	2,794,585	8.72	763,140	(b)	4,944,723	(c)	2,613,513
1897	435,851	3,582,037	8.22	685,048	(b)	4,094,704	(c)	2,623,305
1898	474,419	4,016,822	8.47	358,372	$279,993	6,093,071	(c)	3,115,318
1899	580,751	4,750,424	8.18	476,191	329,969	8,641,882	$416,235	3,682,394
1900	546,679	4,764,124	8.71	289,698	323,630	9,830,517	462,541	2,976,281
1901	605,077	5,484,134	9.06	372,131	463,709	9,870,421	423,371	3,143,001
1902	617,192	5,744,530	9.31	335,290	471,163	11,970,511	630,924	3,506,787
1903	654,499	6,453,849	9.86	328,387	569,689	[c]14,062,369	(c)	4,639,214
1904	735,489	7,557,425	10.28	300,233	545,397	11,167,972	(c)	5,348,555
1905	665,879	6,703,710	10.07	293,907	636,279	12,735,404	645,432	5,850,210

[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, is included in fire brick in 1903; in miscellaneous in 1904.

Products of clay in the United States, 1894–1905, by varieties—Continued.

Year.	Sewer pipe (value).	Architectural terra cotta (value).	Fireproofing. (value).	Hollow building tile or blocks (value).	Tile, not drain (value).	Pottery (value).	Miscellaneous (value).	Total value.
1894........	$5,989,923	$1,476,185	$514,637	(a)	$1,688,724	(b)	$4,517,709	$64,655,385
1895........	4,482,577	2,512,193	741,626	(a)	2,572,628	(b)	6,619,333	65,409,806
1896........	4,588,503	2,359,983	1,706,504	(a)	1,618,127	$7,455,627	1,210,719	63,110,408
1897........	4,069,534	1,841,422	1,979,259	(a)	1,476,638	10,309,209	1,413,595	62,359,991
1898........	3,791,057	2,043,325	1,900,642	(a)	1,746,024	14,589,224	2,000,743	74,487,680
1899........	4,560,334	2,027,532	1,665,066	(a)	1,276,300	17,250,250	6,065,928	95,797,370
1900........	5,842,562	2,372,568	1,820,214	(a)	2,349,420	19,798,570	2,896,036	96,212,345
1901........	6,736,969	3,367,982	1,860,269	(a)	2,867,659	22,463,860	2,945,268	110,211,587
1902........	7,174,892	3,526,906	3,175,593	(a)	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
1905........	10,097,089	5,003,158	3,004,526	1,094,267	3,647,726	27,918,894	3,564,111	149,697,188

a Hollow building tile or blocks included in fireproofing prior to 1903.
b Pottery, unclassified in 1894 and 1895, is included in miscellaneous in each of those years.

This table shows the progress of the clay-working industries for the twelve years covered by the statistical canvass of this office, and is interesting in showing the almost steady growth of these important industries.

The total value of products has increased from $64,655,385 in 1894, or $62,359,991 in 1897 (the minimum), to $149,697,188, the maximum, in 1905, an increase of $87,337,197, or 140.05 per cent over the minimum. The following products reached their maximum value in 1905: Common building brick, front brick, enameled brick, stove lining, drain tile, sewer pipe, architectural terra cotta, tile (not drain), and pottery. Those not reaching the maximum were vitrified paving brick, fancy or ornamental brick, fire brick, fireproofing, and hollow building tile or blocks.

Common brick have increased in number from 5,292,532,000 in 1897 to 9,817,355,000 in 1905, a gain of 4,524,823,000, or 85 per cent; and their value increased from $26,430,207 in 1897 to $61,394,383 in 1905, a gain of $34,964,176, or 132 per cent. The average price per thousand has ranged from $4.99 in 1897 to $6.25 in 1905.

Front brick increased in value from $3,390,941 in 1896 to $7,108,092 in 1905, a gain of $3,717,151, or 110 per cent. The average price per thousand ranged from $10.86 in 1899 to $13.12 in 1905. The number of brick increased from 270,335,000 in 1896 to 541,590,000 in 1905, a gain of 271,255,000, or a little more than 100 per cent.

Vitrified paving brick showed its minimum quantity and value in 1896 when they were 320,407,000 and $2,794,585, respectively, while the maximum was in 1904, when 735,489,000 were reported, valued at $7,557,425. The lowest average price per thousand was in 1894, $8.12, and the highest, $10.28, in 1904.

The enameled brick figures show that this industry has increased the value of its output since separate figures were obtained for it, except in two years, the product in 1905 reaching a maximum value of $636,279.

The fire-brick industry, one of the most important of the clay-working industries, has varied more or less with the iron and steel industries, where fire brick finds its greatest use, reaching its maximum in 1903, declining in 1904, and rising again in 1905, with good prospects for a further increase in 1906.

Drain tile also varies from year to year, according to local demand. The maximum value of this product was $5,850,210, reported in 1905.

Sewer pipe has advanced steadily from the minimum value, $3,791,057, in 1898, to the maximum, $10,097,089, in 1905, a gain in seven years of $6,306,032, or 166 per cent.

Architectural terra cotta has varied from year to year, sometimes gaining and sometimes falling off, though the tendency in recent years is upward.

Fireproofing and tile, not drain, have also varied from year to year, with a probability of large increases in the future.

The pottery industry has shown a steady gain, with the exception of 1904—from $7,455,627 in 1896 to $27,918,894 in 1905, a gain of $20,463,267, or 274 per cent.

RANK OF STATES.

In the following table will be found a statement of the rank of the States in the value of clay products, the number of operating firms reporting, the value of the products by States, and the percentage of the total value produced by each State in 1904 and 1905:

Rank of States, value of output, and percentage of total value of clay products in 1904 and 1905.

State.	1905.				1904.			
	Rank.	Number of operating firms reporting.	Value.	Per cent of total product.	Rank.	Number of operating firms reporting.	Value.	Per cent of total product.
Ohio	1	792	$28,303,039	18.91	1	819	$25,647,783	19.57
Pennsylvania	2	516	19,124,553	12.78	2	529	16,821,863	12.84
New Jersey	3	163	16,699,525	11.16	3	161	13,304,047	10.15
New York	4	249	14,486,347	9.68	5	240	10,543,070	8.05
Illinois	5	469	12,361,786	8.26	4	492	10,777,447	8.23
Indiana	6	441	6,499,573	4.34	6	465	5,902,589	4.50
Missouri	7	224	6,203,411	4.14	7	232	5,481,504	4.18
California	8	122	3,865,147	2.58	8	121	3,624,734	2.77
Iowa	9	306	3,392,122	2.27	9	327	3,460,853	2.64
Kentucky	10	121	2,406,350	1.61	10	120	2,087,277	1.59
Maryland	11	68	2,249,367	1.50	13	63	1,872,057	1.43
Georgia	12	95	2,119,746	1.42	12	103	1,920,936	1.47
Massachusetts	13	78	2,050,457	1.37	16	87	1,729,058	1.32
West Virginia	14	62	2,018,795	1.35	11	64	2,074,549	1.58
Virginia	15	94	1,994,578	1.33	15	99	1,736,392	1.33
Kansas	16	68	1,906,360	1.27	14	69	1,843,630	1.41
Michigan	17	154	1,765,707	1.18	17	168	1,714,513	1.31
Texas	18	129	1,718,945	1.15	18	152	1,536,097	1.17
Colorado	19	94	1,633,231	1.09	25	90	1,189,291	.91
Connecticut and Rhode Island	20	42	1,608,578	1.08	23	43	1,215,609	.93
Minnesota	21	111	1,499,386	1.00	21	114	1,319,907	1.01
Tennessee	22	121	1,493,279	1.00	19	110	1,435,785	1.10
Alabama	23	111	1,392,871	.93	22	118	1,289,548	.98
Wisconsin	24	157	1,382,115	.92	20	159	1,390,994	1.06
Washington	25	72	1,175,032	.78	24	65	1,200,919	.92
North Carolina	26	177	1,020,161	.68	28	204	897,964	.69
Nebraska	27	102	1,006,743	.67	26	109	1,067,387	.81
Louisiana	28	67	821,109	.55	27	74	1,011,478	.77
Mississippi	29	98	818,897	.55	29	92	775,494	.59
South Carolina	30	67	749,835	.50	30	68	732,033	.56
Arkansas	31	65	643,959	.43	31	69	696,582	.53
Maine	32	64	619,294	.41	32	64	558,361	.43
New Hampshire	33	33	554,734	.37	33	35	479,985	.37
Utah	34	54	544,578	.36	35	51	419,726	.32
Oregon	35	63	380,575	.25	34	65	446,340	.34
Indian Territory	36	28	374,235	.25	38	22	268,926	.21
Florida	37	22	329,738	.22	40	17	252,864	.19
District of Columbia	38	14	317,021	.21	36	15	306,460	.23
Montana	39	29	313,006	.21	37	25	279,431	.21
North Dakota	40	19	232,432	.16	43	15	147,579	.11
Idaho and Nevada	41	49	230,780	.15	41	48	199,417	.15
Delaware	42	25	227,064	.15	42	24	158,970	.12
Oklahoma	43	27	222,064	.15	39	33	262,098	.20
New Mexico	44	18	141,722	.09	44	15	108,764	.08
Vermont	45	11	112,967	.08	45	12	100,153	.08
Arizona	46	16	90,436	.06	46	18	68,885	.05
South Dakota	47	11	58,271	.04	47	13	63,203	.05
Wyoming	48	7	34,556	.02	48	10	35,845	.03
Other States	......	....	a502,711	.34	......	....	a564,851	.43
Total	......	5,925	149,697,188	100.00	......	6,108	131,023,248	100.00

a Undistributed pottery products.

From this table it will be seen that every State and Territory is a producer of clay products, the value of the products in 1905 ranging from $34,556, or 0.02 of 1 per cent, in Wyoming, to $28,303,039, or 18.91 per cent of the total, in Ohio.

Ohio is first in both years, as she has been since the canvass of the clay-working industries began by this office, with a product valued at $28,303,039 in 1905. Notwithstanding a considerable gain, other States increased so much more proportionately that Ohio's percentage of the total was actually less in 1905 than it was in 1904. Pennsylvania was second in both years, with a product valued at $19,124,553 in 1905. New Jersey was third in both years, with products valued at $16,699,525 in 1905. New York, which was fifth in 1904, became fourth in 1905, with a product valued at $14,486,347, exchanging places with Illinois and increasing its percentage of the total from 8.05 in 1904 to 9.60 in 1905. Illinois, though making a gain of $1,584,339, or 14.70 per cent, in 1905, fell from fourth place to fifth. Indiana maintained her own in sixth place by $296,162, being greater by that amount than Missouri, which was seventh in both years. In the first ten States there was but one change in relative rank, that already mentioned.

These first ten States marketed wares in 1905 valued at $113,341,853, or 75.71 per cent of the total production, as compared with $97,651,167 in 1904, their increase being $15,690,686, or over 84 per cent of the entire gain for 1905 of $18,673,940. The first five States reported wares valued at $90,975,250, or 60.77 per cent of the total. In 1904 they reported $77,094,210, or 58.84 per cent of the total.

It seems rather remarkable that there should be such a drop in the value of the products between the fifth and the sixth States, the product dropping in value nearly one-half in both 1904 and 1905. After the sixth State the value seems to decrease more gradually.

Of the remaining States, 17 maintained the same rank in each year, 9 advanced in relative rank, and 12 fell back in rank. Of these changes, the most striking are Colorado, which was 25 in 1904 and advanced to 19 in 1905, though it did not reach its position of 1903, when it stood 13, and Wisconsin and Oklahoma, which were the only others that changed more than three places, dropping, respectively, from 20 to 24 and from 39 to 43.

The number of operating firms reporting has decreased from 6,108 in 1904 to 5,925 in 1905. This does not include the plants which made no sales, of which there was a considerable number notwithstanding the unprecedented prosperity in the industry, nor the large number of new plants which did not get under way during the year commercially, but which will be factors in the production of 1906. Ohio has the largest number of operating firms—792 in 1905, as against 819 in 1904. Of the important States, New York and New Jersey show increases in the number of firms reporting, the former gaining 2 and the latter 9. Tennessee showed the largest gain, 11, notwithstanding which it lost in relative rank in value of products, though the products showed an actual increase in value. It is also notable that while most of the important States showed a decrease in the number of reporting firms, a large number of the smaller producing States showed an increase in the number of firms reporting, though in no case is the increase or decrease large.

BRICK AND TILE.

PRODUCTION.

The following tables show the production and value of the building brick and other structural products of clay, together with fire brick, paving brick, and other clay products used in engineering work, the rank of States, and the percentage of total value of each State in 1904 and 1905, the former year being presented for comparative purposes only:

Brick and tile products of the United States in 1905.

Rank.	State.	Common brick. Quantity.	Common brick. Value.	Average price per thousand.	Vitrified paving brick or block. Quantity.	Vitrified paving brick or block. Value.	Average price per thousand.
		Thousands.			*Thousands.*		
22	Alabama	158,801	$930,568	$5.86	(a)	(a)	$13.29
46	Arizona	11,779	89,836	7.63			
31	Arkansas	87,220	606,671	6.96	(a)	(a)	9.50
8	California	284,205	1,961,909	6.90	(a)	(a)	19.23
18	Colorado	96,058	638,376	6.65	5,083	$51,240	10.08
19	Connecticut and Rhode Island	211,613	1,329,220	6.28	(a)	(a)	19.00
42	Delaware	26,236	210,182	8.01			
39	District of Columbia	28,984	220,680	7.61			
37	Florida	55,242	326,929	5.92			
11	Georgia	275,841	1,444,479	5.24	(a)	(a)	14.00
41	Idaho and Nevada	26,562	208,750	7.86			
4	Illinois	1,125,024	6,259,232	5.56	90,563	973,247	10.75
7	Indiana	279,073	1,630,072	5.84	43,573	474,600	10.89
36	Indian Territory	42,630	260,234	6.10	1,950	15,500	7.95
9	Iowa	193,259	1,366,653	7.07	13,253	134,802	10.17
13	Kansas	214,273	917,084	4.28	75,826	580,695	7.66
10	Kentucky	147,702	862,330	5.84	(a)	(a)	14.27
28	Louisiana	112,237	738,220	6.58			
32	Maine	55,021	341,466	6.21	(a)	(a)	14.99
14	Maryland	210,446	1,423,663	6.76	(a)	(a)	17.96
15	Massachusetts	194,504	1,264,787	6.50			
16	Michigan	211,558	1,152,505	5.45	6,112	81,706	13.37
20	Minnesota	166,233	977,837	5.88	(a)	(a)	14.54
29	Mississippi	118,741	782,549	6.59			
6	Missouri	316,002	2,028,957	6.42	43,375	470,935	10.86
38	Montana	19,004	157,575	8.29	(a)	(a)	16.00
26	Nebraska	131,290	874,695	6.66	(a)	(a)	7.58
33	New Hampshire	79,369	529,734	6.67			
5	New Jersey	465,040	3,090,809	6.65	991	13,803	13.93
44	New Mexico	15,811	112,383	7.11	(a)	(a)	10.00
3	New York	1,518,196	10,297,214	6.78	12,076	149,391	12.37
25	North Carolina	150,880	878,539	5.82	(a)	(a)	9.00
40	North Dakota	24,353	192,424	7.90			
2	Ohio	514,419	3,033,435	5.90	224,086	2,055,120	9.17
43	Oklahoma	27,377	200,064	7.31			
35	Oregon	35,933	261,139	7.27			
1	Pennsylvania	1,036,777	6,532,814	6.30	71,888	750,389	10.44
30	South Carolina	127,063	671,452	5.28			
47	South Dakota	6,848	57,071	8.33			
23	Tennessee	173,379	1,028,653	5.93	(a)	(a)	11.50
17	Texas	202,070	1,209,898	5.99	(a)	(a)	10.47
34	Utah	49,305	311,899	6.33	(a)	(a)	21.70
45	Vermont	15,007	86,467	5.76			
12	Virginia	237,161	1,572,442	6.63	(a)	(a)	10.80
24	Washington	81,022	566,385	6.99	9,763	143,702	14.72
27	West Virginia	69,228	476,630	6.88	24,692	263,449	10.67
21	Wisconsin	186,531	1,260,066	6.76			
48	Wyoming	2,048	19,406	9.48			
	Other States [b]				42,648	545,131	12.78
	Total	9,817,355	61,394,383	6.25	665,879	6,703,710	10.07
	Per cent of brick and tile products		50.42			5.50	
	Per cent of total of clay products		41.01			4.48	

[a] Included in Other States.
[b] Includes all products made by less than three producers in one State.

Brick and tile products of the United States in 1905—Continued.

State.	Front brick.		Average price per thousand.	Fancy or ornamental brick.	Drain tile.	Sewer pipe.	Architectural terra cotta.	Fireproofing.
	Quantity.	Value.		Value.	Value.	Value.	Value.	Value.
	Thousands.							
Alabama	(a)	(a)	$11.20	....	(a)	(a)	....	....
Arizona	(a)	(a)	20.00	....	....	....	....	....
Arkansas	300	$2,650	8.83	....	(a)	....	....	....
California	11,871	302,872	25.51	$31,899	$27,852	$663,044	$215,160	$45,551
Colorado	23,520	253,277	10.77	8,404	14,185	(a)	(a)	(a)
Connecticut and Rhode Island	(a)	(a)	14.01	(a)	....	....	....	....
Delaware	(a)	(a)	20.00	....	(a)	....	....	....
District of Columbia	(a)	(a)	15.05	....	(a)	37,657	....	(a)
Florida	....	....	....	....	(a)	(a)	....	....
Georgia	2,667	28,676	10.75	....	13,500	218,000	(a)	(a)
Idaho and Nevada	978	19,480	19.92	....	....	....	....	....
Illinois	30,447	348,354	11.44	13,567	1,051,852	580,538	(a)	323,550
Indiana	22,212	231,353	10.42	15,520	1,267,691	430,680	(a)	393,985
Indian Territory	352	3,020	8.58	....	....	....	....	....
Iowa	5,676	60,669	10.69	....	1,509,226	(a)	....	....
Kansas	18,743	180,201	9.61	17,010	13,212	(a)	(a)	....
Kentucky	11,558	128,777	11.14	....	28,865	(a)	(a)	....
Louisiana	(a)	(a)	12.41	....	(a)	....	....	....
Maine	1,775	17,750	10.00	....	(a)	(a)	....	....
Maryland	1,426	24,118	16.91	(a)	4,703	....	(a)	....
Massachusetts	2,080	33,971	16.33	(a)	....	....	(a)	(a)
Michigan	693	5,995	8.65	....	205,445	(a)	....	(a)
Minnesota	6,636	85,300	12.85	....	15,770	(a)	....	(a)
Mississippi	1,007	14,453	14.35	....	(a)	....	....	....
Missouri	28,224	362,996	12.86	44,632	59,858	1,101,938	(a)	(a)
Montana	(a)	(a)	20.00	....	....	(a)	....	(a)
Nebraska	(a)	(a)	14.10	(a)	....	....	....	....
New Hampshire	....	....	....	....	....	....	....	....
New Jersey	53,770	852,744	15.86	1,975	24,315	56,576	1,614,263	1,017,774
New Mexico	(a)	(a)	12.71	....	....	....	....	....
New York	12,610	237,305	18.82	(a)	153,598	(a)	874,722	117,577
North Carolina	755	12,725	16.85	(a)	5,620	(a)	....	....
North Dakota	1,429	23,083	16.15	(a)	(a)	....	....	(a)
Ohio	89,390	1,074,007	12.01	18,153	1,291,323	3,550,160	....	606,246
Oklahoma	(a)	(a)	8.80	....	....	....	....	....
Oregon	710	14,800	20.85	(a)	23,718	(a)	....	(a)
Pennsylvania	131,368	1,683,031	12.81	37,966	13,509	886,979	405,015	290,762
South Carolina	(a)	(a)	16.53	....	(a)	....	....	....
South Dakota	....	....	....	....	....	....	....	....
Tennessee	9,983	103,650	10.38	3,672	23,116	(a)	(a)	....
Texas	8,001	102,054	12.76	18,127	....	(a)	....	....
Utah	11,557	128,754	11.14	....	(a)	(a)	....	(a)
Vermont	....	....	....	....	(a)	....	....	....
Virginia	22,155	352,297	15.90	20,363	4,500	....	....	....
Washington	3,304	86,388	26.15	5,425	11,153	242,245	(a)	(a)
West Virginia	(a)	(a)	16.67	....	(a)	(a)	....	....
Wisconsin	4,917	49,275	10.02	1,048	57,576	....	....	....
Wyoming	1,100	15,150	13.77	....	....	....	....	....
Other States[b]	20,376	268,917	13.20	56,146	29,623	2,329,272	1,893,998	209,081
Total	541,590	7,108,092	13.12	[c] 930,186	5,850,210	10,097,089	5,003,158	3,004,526
Per cent of brick and tile products	....	5.84	....	0.76	4.80	8.29	4.11	2.47
Per cent of total of clay products	....	4.75	....	.62	3.91	6.74	3.34	2.01

[a] Included in Other States.
[b] Includes all products made by less than three producers in one State.
[c] Including enameled brick, valued at $636,279, made in the following States: California, Colorado, Illinois, Maryland, Missouri, New Jersey, Ohio, Oregon, and Pennsylvania.

Brick and tile products of the United States in 1905—Continued.

State.	Hollow building tile or blocks.	Tile, not drain.	Stove lining.	Fire brick.		Average price per thousand.	Miscellaneous.[a]	Total value.	Per cent of total value.
	Value.	Value.	Value.	Quantity.	Value.		Value.		
				Thousands.					
Alabama	...	...	...	7,013	$125,244	$17.86	$8,000	$1,358,626	1.11
Arizona	...	...	...	...	...	...	...	90,436	.07
Arkansas	(b)	...	...	528	6,530	12.37	...	623,871	.51
California	$69,114	$34,679	(b)	12,913	290,878	22.53	91,535	3,769,934	3.10
Colorado	(b)	(b)	...	13,296	274,095	20.61	70,675	1,584,236	1.30
Connecticut and Rhode Island	...	...	(b)	(b)	(b)	21.91	...	1,503,478	1.23
Delaware	...	...	...	(b)	(b)	18.00	...	227,064	.19
District of Columbia	...	...	...	...	...	...	16,588	307,109	.25
Florida	...	...	...	(b)	(b)	18.00	...	329,738	.27
Georgia	...	(b)	...	4,970	73,050	14.70	8,000	2,097,356	1.72
Idaho and Nevada	...	...	...	(b)	(b)	26.67	150	230,780	.19
Illinois	15,576	(b)	...	10,767	176,692	16.41	33,996	11,418,779	9.38
Indiana	150,607	(b)	(b)	14,774	163,728	11.08	290,476	5,567,426	4.57
Indian Territory	...	...	...	(b)	(b)	12.00	95,001	374,235	.31
Iowa	137,554	(b)	...	75	869	11.59	20,990	3,321,763	2.73
Kansas	6,802	(b)	...	403	7,334	18.20	53,648	1,906,360	1.56
Kentucky	...	296,949	...	42,678	739,059	17.32	...	2,249,267	1.85
Louisiana	...	...	...	...	...	...	29,474	821,109	.67
Maine	(b)	...	...	(b)	(b)	15.00	50	619,294	.51
Maryland	...	(b)	$32,890	14,042	224,667	16.00	10,000	1,885,009	1.55
Massachusetts	...	82,000	173,151	1,902	68,180	35.85	2,720	1,751,616	1.44
Michigan	3,585	...	(b)	(b)	(b)	19.37	...	1,719,746	1.41
Minnesota	(b)	...	...	(b)	(b)	20.00	212	1,499,386	1.23
Mississippi	...	...	...	(b)	(b)	16.00	150	803,317	.66
Missouri	16,494	(b)	(b)	62,239	1,117,209	17.95	388,268	6,160,043	5.06
Montana	...	...	...	2,257	115,431	51.14	1,000	313,006	.26
Nebraska	(b)	...	...	...	...	...	...	1,006,743	.83
New Hampshire	...	...	...	(b)	(b)	25.00	...	554,734	.45
New Jersey	290,301	585,130	(b)	52,149	1,393,448	26.72	846,888	10,044,191	8.25
New Mexico	(b)	...	...	(b)	(b)	25.00	...	141,722	.12
New York	11,295	164,445	133,383	12,976	427,873	32.97	117,357	12,858,617	10.56
North Carolina	...	(b)	...	(b)	(b)	12.24	7,700	1,006,842	.83
North Dakota	(b)	...	(b)	(b)	(b)	31.21	123	232,432	.19
Ohio	317,516	1,188,460	49,538	94,742	1,427,919	15.07	647,257	15,278,968	12.55
Oklahoma	...	...	...	...	...	...	...	222,064	.18
Oregon	(b)	...	...	62	1,568	25.29	...	380,575	.31
Pennsylvania	61,345	310,931	180,353	312,470	5,771,795	18.47	780,841	17,778,122	14.60
South Carolina	...	...	...	2,560	30,720	12.00	...	720,997	.59
South Dakota	...	...	...	(b)	(b)	40.00	...	58,271	.05
Tennessee	...	...	...	3,271	35,300	10.79	...	1,329,609	1.09
Texas	...	...	...	855	14,724	17.22	18,850	1,618,157	1.33
Utah	...	(b)	...	1,341	35,629	26.57	22,662	544,578	.45
Vermont	...	...	(b)	...	...	...	...	112,967	.09
Virginia	...	...	...	(b)	(b)	14.60	...	1,994,578	1.64
Washington	(b)	...	...	759	24,699	32.54	...	1,133,932	.93
West Virginia	...	(b)	...	2,276	26,868	11.80	...	822,990	.68
Wisconsin	(b)	...	...	...	...	...	1,500	1,369,665	1.12
Wyoming	...	...	...	...	...	...	...	34,556	.03
Other States[c]	14,078	985,132	76,117	8,653	161,895	18.71	...	(d)	...
Total	1,094,267	3,647,726	645,432	679,971	12,735,404	18.73	3,564,111	121,778,294	100.00
Per cent of brick and tile products	0.90	2.99	0.53	...	10.46	...	2.93	100.00	...
Per cent of total of clay products	.73	2.44	.43	...	8.51	...	2.38	81.35	...

[a] Including adobes, aquarium ornaments, art terra cotta, assayer's furnaces, boiler and locomotive tile and tank blocks, brick and tile for chemical purposes, burnt clay ballast, carboy stoppers, chimney radial blocks, pipe tops and caps, clay furnaces, retorts and settings, conduits, crucibles, flue pipe and flue linings, gas logs, glass-house supplies, grave and lot markers, insulators, muffles, oven tile, paving blocks, posts, runner brick, sleeves and nozzles, rustic stumps, saggers, scorifiers, sewer brick and blocks, stone pumps, tuyers, vitrified curb, and wall coping.

[b] Included in Other States.

[c] Includes all products made by less than three producers in one State.

[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 1904.

Rank.	State.	Common brick.			Vitrified paving brick.		
		Quantity.	Value.	Average price per thousand.	Quantity.	Value.	Average price per thousand.
		Thousands.			*Thousands.*		
21	Alabama	150,170	$840,236	$5.60	(a)	(a)	$13.87
46	Arizona	9,507	68,885	7.25			
31	Arkansas	93,799	661,657	7.05			
8	California	256,898	1,843,936	7.18	(a)	(a)	18.08
23	Colorado	85,220	544,661	6.39	(a)	(a)	9.67
24	Connecticut and Rhode Island	186,908	1,039,204	5.56	(a)	(a)	14.00
42	Delaware	18,656	152,470	8.17			
36	District of Columbia	26,913	194,695	7.23			
40	Florida	44,484	248,579	5.59			
11	Georgia	269,815	1,374,318	5.09	(a)	(a)	12.00
41	Idaho	20,665	160,102	7.75	(a)	(a)	25.00
3	Illinois	999,310	5,167,165	5.17	121,073	$1,234,703	10.20
7	Indiana	283,707	1,677,714	5.91	51,859	513,209	9.90
38	Indian Territory	34,730	217,338	6.26	(a)	(a)	7.44
9	Iowa	207,041	1,440,758	6.96	19,231	199,528	10.38
12	Kansas	202,821	890,474	4.39	81,441	621,424	7.63
10	Kentucky	138,677	796,074	5.74	(a)	(a)	14.91
27	Louisiana	145,259	914,585	6.29	(a)	(a)	10.07
32	Maine	50,499	326,240	6.46	(a)	(a)	15.02
15	Maryland	160,279	1,048,850	6.54	(a)	(a)	10.08
16	Massachusetts	165,435	1,012,226	6.12	(a)	(a)	14.00
14	Michigan	205,196	1,116,714	5.44	(a)	(a)	13.28
19	Minnesota	164,154	970,247	5.91	(a)	(a)	10.00
29	Mississippi	110,183	710,878	6.45			
6	Missouri	271,370	1,690,460	6.23	47,235	480,671	10.17
37	Montana	18,176	145,642	8.01	(a)	(a)	16.00
25	Nebraska	133,074	904,750	6.80	5,531	45,063	8.15
49	Nevada	2,800	25,100	8.96			
33	New Hampshire	70,290	446,603	6.35			
5	New Jersey	319,975	1,842,075	5.76	4,953	66,813	13.49
44	New Mexico	11,694	79,927	6.83	(a)	(a)	10.00
4	New York	1,169,233	6,783,528	5.80	14,490	189,281	13.06
28	North Carolina	137,453	760,161	5.53	430	3,850	8.95
43	North Dakota	17,390	134,017	7.71			
2	Ohio	455,936	2,708,456	5.94	218,791	2,222,931	10.16
39	Oklahoma	33,813	233,280	6.90	(a)	(a)	7.00
34	Oregon	40,217	302,098	7.51			
1	Pennsylvania	856,963	5,439,116	6.35	71,522	766,638	10.72
30	South Carolina	131,198	665,688	5.07			
47	South Dakota	7,255	59,603	8.22			
20	Tennessee	158,223	946,131	5.98	(a)	(a)	11.80
17	Texas	197,033	1,157,130	5.87	(a)	(a)	8.81
35	Utah	40,128	255,358	6.36	(a)	(a)	9.00
45	Vermont	13,102	78,237	5.97			
13	Virginia	203,484	1,292,558	6.35	(a)	(a)	10.46
22	Washington	87,732	665,878	7.59	9,233	149,559	16.20
26	West Virginia	68,133	469,501	6.89	39,620	470,339	11.87
18	Wisconsin	186,292	1,230,620	6.61			
48	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. Quantity.	Front brick. Value.	Front brick. Average price per thousand.	Fancy or ornamental brick (value).	Drain tile (value).	Sewer pipe (value).	Architectural terra cotta (value).
	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[b]	9,336	123,248	13.20	76,981	29,441	1,694,052	1,339,155
Total	434,351	5,560,131	12.80	[c]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] 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 $545,397, made in the following States: California, Colorado, Illinois, Maryland, Missouri, New Jersey, Ohio, and Pennsylvania.

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. Quantity.	Fire brick. Value.	Fire brick. Average price per thousand.	Miscellaneous (value).[a]	Total value.	Per cent of total value.
				Thousands.					
Alabama				8,596	$140,678	$16.37	$10,000	$1,257,015	1.19
Arizona								68,885	.07
Arkansas				671	10,800	16.10		675,332	.64
California	$51,125	$45,751	(b)	12,534	285,718	22.80	112,720	3,553,016	3.36
Colorado	(b)	(b)	(b)	4,606	110,053	23.89	45,000	1,153,921	1.09
Connecticut and Rhode Island			(b)	1,849	43,500	23.53		1,146,034	1.08
Delaware								158,970	.15
District of Columbia	(b)						8,770	296,443	.28
Florida				(b)	(b)	14.08		252,864	.24
Georgia	(b)		(b)	3,460	28,100	8.12	9,069	1,898,879	1.79
Idaho				(b)	(b)	28.85		173,597	.16
Illinois	324,264	6,460	$194,471	16,916	217,008	12.83	41,572	9,947,751	9.40
Indiana	210,800	219,476	(b)	11,260	130,216	11.56	254,681	5,198,898	4.91
Indian Territory				254	4,475	17.62	23,756	268,926	.25
Iowa		161,658	4,300	(b)	(b)	15.00	105,000	3,392,719	3.21
Kansas		(b)	(b)	385	4,375	11.36	45,581	1,843,630	1.74
Kentucky	(b)		(b)	40,948	680,084	16.61		1,929,664	1.82
Louisiana							31,400	1,009,274	.95
Maine				(b)	(b)	15.04		558,361	.53
Maryland			(b)	11,084	235,136	21.21	33,612	1,469,126	1.39
Massachusetts	(b)		72,000	(b)	(b)	20.83	195,773	1,440,743	1.36
Michigan		8,080		(b)	(b)	13.00		1,670,892	1.58
Minnesota	(b)	(b)						1,319,907	1.25
Mississippi		(b)						760,793	.72
Missouri	(b)	(b)	(b)	48,607	925,520	19.04	342,327	5,410,686	5.11
Montana	(b)	(b)		1,797	102,611	57.10	1,480	279,431	.26
Nebraska							3,502	1,067,387	1.01
Nevada								25,820	.02
New Hampshire				(b)	(b)	27.24		479,985	.45
New Jersey	947,253	264,393	548,097	39,752	908,882	22.86	416,745	7,354,294	6.95
New Mexico								108,764	.10
New York	132,034	24,050	154,417	19,792	381,784	19.29	248,224	9,228,432	8.72
North Carolina				174	2,778	15.97		883,964	.84
North Dakota	(b)			(b)	(b)	34.53		147,579	.14
Ohio	476,276	312,549	1,005,611	79,939	1,186,966	14.85	581,545	13,978,485	13.20
Oklahoma				(b)	(b)	20.00	11,618	262,098	.25
Oregon	(b)	(b)		49	1,599	32.63	300	446,340	.42
Pennsylvania	139,036	54,154	215,107	275,592	5,477,475	19.88	1,042,282	15,421,981	14.57
South Carolina				3,377	36,960	10.94		716,458	.68
South Dakota		(b)		(b)	(b)	20.00		63,203	.06
Tennessee	(b)			4,390	53,185	12.12		1,284,201	1.21
Texas		(b)	(b)	1,982	30,208	15.24	66,593	1,429,596	1.35
Utah				(b)	(b)	13.60	6,565	419,726	.40
Vermont							20,000	100,153	.09
Virginia				(b)	(b)	17.73		1,708,728	1.62
Washington		(b)		711	22,445	31.57	9,767	1,178,919	1.11
West Virginia			(b)	896	11,814	13.19		1,009,344	.95
Wisconsin		(b)					1,400	1,377,919	1.30
Wyoming								35,845	.03
Other States[c]	221,815	29,927	829,425	8,139	135,602	16.66		(d)	
Total	2,502,603	1,126,498	3,023,428	597,760	11,167,972	18.68	3,669,282	105,864,978	100.00
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, stove lining, 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.

These tables show the details by States of the production of the coarser clay products in 1904 and 1905. The total value of these products in 1905 was $121,778,294, as compared with $105,864,978 in 1904, a gain of $15,913,316, or 15.03 per cent. These products composed 81.35 per cent of all clay products in 1905 and 80.80 per cent in 1904. In 1904 the increase over 1903 was $238,609, or 0.23 of 1 per cent. In 1903 the value of these products was $105,626,369, and they composed 80.59 per cent of the total clay products.

The common-brick industry, which is the most widespread of all the clay-working industries, continues to grow, and composed slightly more than one-half of the brick and tile value and 41.01 per cent of all clay products. The quantity of this product increased from 8,665,171,000 in 1904 to 9,817,355,000 in 1905, a gain of 1,152,184,000, while the value increased from $51,768,558 in 1904 to $61,394,383, a gain of $9,625,825. In 1903 the common brick reported were 8,463,683,000, valued at $50,532,075.

New York continues to be by far the largest producer of common brick, reporting 1,518,196,000 in 1905, valued at $10,297,214, or $6.78 per thousand. This number is 15.46 per cent of the total production reported for the entire country, and the value is 16.77 per cent of the total. In 1904 also New York was the largest producer of common brick, marketing 1,169,233,000, valued at $6,783,528, or $5.80 per thousand. In 1903 the average price of common brick in New York State was $4.96. Most of this brick, as shown elsewhere, comes from the Hudson River region. The next largest producer of common brick is Illinois, which marketed 1,125,024,000 in 1905, valued at $6,259,232, or $5.56 per thousand; in 1904 also this State was second, marketing 999,310,000 common brick, valued at $5,167,165, or $5.17 per thousand. The only other State to produce more than 1,000,000,000 common brick was Pennsylvania, which marketed 1,036,777,000 brick, valued at $6,532,814, or $6.30 per thousand. In 1904 also Pennsylvania was third in the production of common brick, reporting 856,963,000 brick, valued at $5,439,116, or $6.35 per thousand. It will be noted that in 1905 this State, though third in quantity, was second in value of common brick, its product being valued at $273,582 more than that of Illinois, though the product of the latter was greater by 88,247,000. Ohio was fourth in production as in 1904, reporting 514,419,000, and New Jersey fifth, reporting 465,040,000, though the latter's product was valued at $3,090,809, as against $3,033,435 for Ohio. The remaining States range from Missouri, with 316,002,000 brick, valued at $2,028,957, to Wyoming, with 2,048,000 brick, valued at $19,406.

The average price per thousand for common brick ranged from $9.48 in Wyoming to $4.28 in Kansas, the latter being unusually low on account of the low fuel cost of natural gas.

The vitrified paving brick industry showed a falling off in 1905 both in quantity and value. The former declined from 735,489,000 in 1904 to 665,879,000 in 1905, while the latter declined from $7,557,425 in 1904 to $6,703,710 in 1905. The prospects for 1906, however, seem good, and the probability is that this product will show a gain in this year. Ohio is by far the largest producer of this variety of brick, its clays and shales being especially adapted to the production of vitrified wares of the coarser varieties. In 1905 it marketed 224,086,000 paving brick or block, or a little over one-third of the production of the entire country, while the value of its production was a little less than one-third of the total—31 per cent. Illinois, Kansas, and Pennsylvania were the States next in order of production, though the value of Pennsylvania's product was $169,694 more than that of Kansas, while its product was 3,938,000 brick less. Indiana was fifth in both quantity and value, reporting 43,573,000 vitrified brick or block, valued at $474,600. In 1904 these same relative positions were maintained. The average price per thousand in 1905 was $10.07 as compared with $10.28 in 1904. The average price per thousand ranged from $21.70 in Utah to $7.58 in Nebraska. As there was only a small production in Utah, it would hardly be fair to take this price as an average value. Washington, where the average is

$14.72, is probably a fairer State to accept as the maximum. Vitrified brick composed 5.50 per cent of all brick and tile products and 4.48 per cent of all clay products in 1905, as against percentages of 7.14 and 5.77, respectively, in 1904.

The front-brick product increased from 434,351,000 in 1904 to 541,590,000 in 1905, a gain of 107,239,000, or 24.69 per cent, and the value increased from $5,560,131 to $7,108,092, a gain of $1,547,961, or 27.84 per cent. This product is produced in greatest quantity in Pennsylvania, where 131,368,000 were reported for 1905, valued at $1,683,031, or $12.81 per thousand. The next largest producer of this variety of brick is Ohio, where 89,390,000 were reported, valued at $1,074,007, or $12.01 per thousand. New Jersey was third with a product of 53,770,000, valued at $852,744, or $15.86 per thousand. Illinois, fourth in quantity, produced, 30,447,000, valued at $348,354, or $11.44 per thousand, though the value of this product is exceeded by Missouri, which is fifth in quantity, 28,224,000, valued at $362,996, and by Virginia, which is eighth in quantity, 22,155,000, but fifth in value, $352,297. Front brick composed 5.84 per cent of the brick and tile products and 4.75 per cent of all clay products in 1905. In 1904 these percentages were 5.25 and 4.24, respectively. In 1904 Pennsylvania, Ohio, New Jersey, Missouri, and Illinois ranked in production in the order given, but in value of product Virginia exceeded Missouri and Illinois.

Drain tile is produced principally in the Middle West, Iowa being the State where the product of largest value was reported in both 1905 and 1904, the former being $1,509,226 and the latter $1,294,134. Ohio was the next largest producer in 1905, with a product valued at $1,291,323; in 1904 Indiana was the second State in value of product. In 1905 Indiana was third with the product valued at $1,267,691, and Illinois was fourth, reporting $1,051,852 worth of drain tile. These four States produced tile valued at $5,120,092, or 87.52 per cent of the total for the country. This product was 4.80 per cent of the brick and tile products and 3.91 per cent of all clay products in 1905, and 5.05 per cent and 4.08 per cent, respectively, in 1904.

Sewer pipe is another product which is produced on a large scale in a comparatively small number of States. This product was reported by 27 States, 8 of which reported 76 per cent of the total. The leading State in value of production is Ohio, which produced sewer pipe valued at $3,550,160, a small gain over 1904, when its product was valued at $3,495,917. The next most important producer was Missouri, with a product valued at $1,101,938, followed by Pennsylvania, reporting a product valued at $886,979. These three States maintained the same rank in 1904. In each year they produced more than one-half of the entire product. Sewer pipe composed 8.29 per cent of the brick and tile products and 6.74 per cent of all clay products; in 1904 these figures were, respectively, 8.68 and 7.01.

Architectural terra cotta, being one of the highest grades of structural materials, requires special clay and special skill. It is therefore produced by few clay workers, there being three or more in only four States in both 1904 and 1905. New Jersey is the leading State, reporting ware valued at $1,614,263 in 1905, or nearly one-third of the entire amount. In 1904, also, this State was first, producing ware valued at $1,412,023. New York was second in 1905, with a product valued at $874,722, as against $785,978 in 1904. Architectural terra cotta was 4.11 per cent of the brick and tile products in 1905 and 3.34 per cent of all clay products.

The fireproofing industry is one of growing importance in consequence of its extended use in the erection of business structures. It is a product that will stand transportation, though it is most largely manufactured in the States contiguous to large cities. New Jersey, which supplies a large proportion of the Eastern States, is the leading State in the production of this material, reporting $1,017,774 worth, or over one-third of the entire product. In 1904, also, this State was the leading one, producing about the same proportion of the entire product. Ohio was second in 1905, with a product valued at $606,246, and Indiana and Illinois were third and fourth, respectively. Fireproofing was 2.47 per cent of the total brick and tile products in 1905 and 2.01 per cent of the total clay products; in 1904 these figures were, respectively, 2.36 and 1.91.

The hollow building block or tile product does not seem to have maintained its popularity, though it was reported from 21 States in 1905 and from 20 in 1904. Ohio was the largest producer, reporting a product worth $317,516, or nearly one-third of the entire output, with New Jersey second and Indiana third. These relative ranks were the same in 1904.

Tile, not drain, is an interesting item, since it embraces wares which enter almost exclusively into the finer structures. These materials are roofing tile, floor, wall, and art tile. These products are made in 18 States, but in only 7 are there three or more producers. Ohio is the leading producer, reporting $1,188,460 worth in 1905, as compared with $1,005,611 in 1904. New Jersey was second in both years and Pennsylvania third in both years.

The fire-brick industry is one of great importance and is quite widespread, 40 States reporting this product in 1905. In view of the fact that fire brick is made in a great variety of shapes and sizes, a simple statement of the number marketed would be meaningless. In order to arrive at some definite unit, producers were asked to reduce their product to the equivalent of the standard 9-inch fire brick. On this basis the quantity increased from 597,760,000 in 1904 to 679,971,000 in 1905, an increase of 82,211,000, or 13.75 per cent, while the value increased $1,567,432, or 14.04 per cent. Pennsylvania is the leading State, reporting 312,470,000 9-inch brick, or their equivalent, valued at $5,771,795, or $18.47 per thousand. This value is 45.95 per cent of the total value of the fire brick. In 1904, also, Pennsylvania was first in production and value. Ohio was second in production and value in 1905, reporting 94,742,000 brick, valued at $1,427,919, or $15.07 per thousand. New Jersey was third in value of product, reporting 52,149,000 brick, valued at $1,393,448, or $26.72 per thousand. Missouri was fourth in value of product, $1,117,209, or $17.95 per thousand, although the number of brick reported in Missouri, 62,239,000, was larger by 10,099,000 than the number reported by New Jersey. These four States produced 76.71 per cent of the total. No other State reported a product valued at as much as $1,000,000, though Kentucky came nearest to this figure with a value reported at $739,059. The other States are comparatively small producers, the largest being New York, which reported fire brick valued at $427,873, or 3.36 per cent of the total. The average price per thousand in 1905 ranged from $10.79 in Tennessee to $35.85 in Massachusetts, Pennsylvania's average, $18.47, being nearest the average for the country, $18.73. The relative rank of these four principal States in quantity of product was the same in 1904. Fire brick composed 10.46 per cent of the brick and tile products and 8.51 per cent or all clay products. In 1904 these figures were 10.55 and 8.52, respectively. The average price per thousand in 1904 was $18.68.

While Ohio is the leading State in the value of all clay products, Pennsylvania is the leading State in the brick and tile products as classified by this office, its output being 14.60 per cent of the total, as against 12.55 per cent of the total for Ohio. Pennsylvania's product showed a gain of $2,356,141, or 15.28 per cent, and Ohio gained $1,300,483, or 9.30 per cent, over their respective values in 1904. New York was third in 1905, displacing Illinois, which was third in 1904. New York's products in 1905 were valued at $12,858,617, as compared with $9,228,432 in 1904, a gain of 39.34 per cent. In 1905 New York's product was 10.56 per cent of the total, while in 1904 it was 8.72 per cent. Illinois was fourth in 1905, with a gain of $1,471,028, or 14.79 per cent. In 1905 the product of this State was 9.38 per cent and in 1904 9.40 per cent of the total brick and tile products. New Jersey was fifth each year, with a gain in 1905 of $2,689,897, or 36.58 per cent. Its percentage of the brick and tile total in 1905 was 8.25, and in 1904 it was 6.95. Missouri was sixth in value of brick and tile products in both 1904 and 1905, having a gain in 1905 of $749,357, or 13.85 per cent. Indiana was seventh in both years, gaining $368,528, or 7.09 per cent, in

1905. The percentage of the total brick and tile products contributed by Indiana was 4.91 in 1904 and 4.57 in 1905. These seven States reported 64.96 per cent of the total brick and tile products in 1905, and in 1904 they produced 62.85 per cent of this total.

HUDSON RIVER REGION.

While this region is always an interesting one from the viewpoint of the clay-working industry, in 1905 it was especially so on account of its wonderful prosperity because of the phenomenal growth of the building industry in Greater New York, for which this region is the principal source of supply of common building brick. This region is peculiarly favored by immense deposits of clay along the banks of the Hudson River, which are especially adapted to the manufacture of common brick, and the river affords a cheap and convenient method of transportation.

To the New York portion of this region should be given the credit of making this State the largest common brick-producing State in the Union, as it marketed in 1905 1,229,666,000 of New York's total of 1,518,196,000 common brick, or nearly four-fifths of the State's entire product. New York's portion of this region produced more brick in 1905 than any State in the Union, the nearest approach to it being Illinois, which marketed 1,125,024,000 brick, but the value of the output of New York's portion of this region was 37.61 per cent greater than that of the Illinois product.

The entire region on both sides of the Hudson River from Cohoes to New York embraces ten counties—nine in New York and one in New Jersey. These counties marketed in 1905 1,297,389,000 common brick (almost the entire product going to New York City), valued at $9,063,753, or $6.99 per thousand, as against 987,644,000 brick in 1904, valued at $5,810,114, or $5.88 per thousand, a gain of 309,745,000 brick, or 31.36 per cent in number and of $3,253,639, or 56 per cent in value, thus showing that while the gain in production was great the increase in value was even greater. This is further shown by the fact that the price of brick at the kiln has increased in a few years from about $4 per thousand to $7, or more. The great prosperity in this region in 1904 resulted in the number of reporting firms increasing from 119 in 1904 to 129 in 1905. It is safe to say that every yard along the Hudson River was operated to its fullest capacity during the season of 1905, which was quite a prolonged one on account of favorable weather, shipments being made regularly from the lower part of the region until the end of the year.

The New York portion of this region reported 1,229,666,000 common brick, or 94.78 per cent of the total, valued at $8,613,148, or 95.03 per cent, while the New Jersey portion supplied 5.22 per cent of the product and 4.97 per cent of the value. There was a gain of 32.40 per cent in 1905 in the product of the New York portion of the region and a gain of 57.39 per cent in the value of this product. The New Jersey portion increased its production from 58,926,000 in 1904 to 67,723,000 in 1905, a gain of 8,797,000, or 14.93 per cent, while the value of the product in this portion of the region increased $112,829, or 33.40 per cent.

Of these counties, Rockland was the largest producer in 1905, reporting 324,583,000 brick, valued at $2,407,500, or $7.42 per thousand. In 1904 Ulster County was the largest producer of brick, though the greatest value was obtained in Rockland County. Ulster was the second largest producing county in 1905, reporting 278,556,000 brick, valued at $1,806,691, or $6.49 per thousand. These two counties report nearly one-half of both the production and the value reported from the New York portion of the region. In these two counties are located the great brick-producing regions near Rondout and at Haverstraw. Dutchess County was third in output and value of product, while in Greene County the highest average price per thousand, $7.59, was realized, the averages ranging from this price to $5.23 in Rensselaer County. Rensselaer was also the smallest producing county in the region, reporting only 17,200,000, valued at $89,900.

Bergen is the only New Jersey county included in this region.

Comparing the production of the largest of these counties with some of the States of the Union, it will be observed that Rockland County produced more common brick than any State except Illinois, New Jersey, Ohio, and Pennsylvania, and that Ulster County's output was exceeded only by California, Illinois, Indiana, Missouri, New Jersey, Ohio, and Pennsylvania. In fact, the value of common brick reported from Rockland County in 1905 exceeds the value of all clay products reported from any State except the first nine, namely, Ohio, Pennsylvania, New Jersey, New York, Illinois, Indiana, Missouri, California, and Iowa, and the value of Ulster County was exceeded by only sixteen States. The value of the common brick of the entire region, $9,063,753, was exceeded by only five States.

Production of common brick in the Hudson River district, from Cohoes to New York City, in 1904 and 1905, by counties.

County.	1904.				1905.			
	Number of firms reporting.	Quantity.	Value.	Average price per thousand.	Number of firms reporting.	Quantity.	Value.	Average price per thousand.
		Thousands.				*Thousands.*		
Albany	8	61,977	$328,500	$5.30	10	71,992	$496,029	$6.89
Columbia	5	70,200	466,000	6.64	6	82,260	596,663	7.25
Dutchess	16	150,997	850,030	5.63	16	182,807	1,237,597	6.77
Greene	4	37,551	241,444	6.43	6	49,338	374,720	7.59
Orange	8	92,643	552,064	5.96	8	141,930	1,015,776	7.16
Rensselaer	6	17,385	83,963	4.83	5	17,200	89,900	5.23
Rockland	32	219,263	1,400,016	6.39	34	324,583	2,407,509	7.42
Ulster	22	226,452	1,240,296	5.48	23	278,556	1,806,691	6.49
Westchester	7	52,250	310,025	5.94	9	81,000	588,272	7.26
Total for New York	108	928,718	5,472,338	5.89	117	1,229,666	8,613,148	7.00
Bergen County, N. J.	11	58,926	337,776	5.73	12	67,723	450,605	6.65
Total	119	987,644	5,810,114	5.88	129	1,297,389	9,063,753	6.99

POTTERY.

INTRODUCTION.

The year 1905 was a most satisfactory one, judging from the value of the output reported, which increased $2,760,624. It will be noted that the increase in 1905 is almost ten times as great as the loss of 1904. The increase is rather surprising in view of the fact that the agreement among certain potters to maintain prices was given up early in the year. At that time the effect of this abandonment was problematical, though it was feared that it would be disastrous to the industry. This does not appear to have been the result, certainly not so far as the total value of the product is concerned. Whether or not the year was satisfactory to the operators from a financial point of view, they alone know. The increasing proportion of domestic production compared with imports, and the wider market of his wares, should, however, be sources of satisfaction to the American potter.

The total value of the product rose from $25,158,270 in 1904 to $27,918,894 in 1905, a gain of $2,760,624 or 10.97 per cent, thus much more than overcoming the slight decrease of 1904, $277,782 or 1.09 per cent. The decrease of 1904 is the only one recorded by this office since 1896, when its canvass of the pottery industry began. The imports of pottery showed a large increase (see p. 37), but the production more than kept pace with them, and the percentage of the domestic product entering into consumption was greater in 1905 than in 1904.

PRODUCTION.

In the following tables will be found the statistics of the production of the pottery industry in the United States in 1904 and 1905, by States and Territories:

Value of pottery products in 1905, by varieties of products, by States.

Rank of State.	State.	Number of active firms.	Red earthenware.	Stoneware.	Yellow and Rockingham ware.	C. C. ware.	White granite, semiporcelain ware, and semivitreous porcelain ware.
20	Alabama	26	$2,700	$31,545			
23	Arkansas	3	(a)	17,768			
14	California	18	41,547	11,812			
16	Colorado	6	6,891	(a)	(a)		
12	Connecticut	4	34,850	(a)			
27	District of Columbia	3	9,912				
	Florida		(a)	(a)			
22	Georgia	19	5,512	16,378			
6	Illinois	24	25,350	864,507	(a)		
7	Indiana	17	5,397	69,065	(a)		(a)
15	Iowa	8	9,400	59,459			
	Kansas			(a)			
11	Kentucky	12	22,674	134,409			
	Louisiana		(a)				
	Maine			(a)			
8	Maryland	10	13,325		(a)	(a)	$195,000
9	Massachusetts	13	185,074	23,876		(b)	
17	Michigan	5	(a)			(a)	
	Minnesota		(a)	(a)			
24	Mississippi	7	(a)	14,730			
18	Missouri	14	4,054	39,314			
	Montana		(a)				
	New Hampshire						
2	New Jersey	49	19,650	51,173		(b)	1,288,926
3	New York	23	32,240	51,540			(a)
25	North Carolina	24	387	12,932			
1	Ohio	123	137,705	1,310,302	$177,143	$609,478	8,521,944
	Oregon		(a)	(a)			
4	Pennsylvania	49	149,786	309,325	(a)		716,245
21	South Carolina	8	6,670	21,968		(b)	
10	Tennessee	14	(a)	115,580			
13	Texas	17	6,114	94,674			
	Utah		(a)				
	Virginia						
19	Wash ngton	4	6,300	34,800			
5	West Virginia	12		19,110		(a)	754,195
26	Wisconsin	4	11,950				
	Other States c		43,149	404,548	83,056	228,961	494,665
	Total	d 533	780,637	3,708,817	260,199	838,439	11,970,975
	Per cent of pottery products		2.80	13.28	0.93	3.00	42.88
	Per cent of total clay products		.52	2.53	.16	.56	7.99

a Included in Other States.
b C. C. ware for Massachusetts, New Jersey, and South Carolina is included in the miscellaneous column of each of these States.
c Includes all products made by less than three producers in one State. The total of other States is distributed among the States to which it belongs.
d Includes seventeen firms not distributed.

Value of pottery products in 1905, by varieties of products, by States—Continued.

Rank of State.	State.	China.	Bone china, delft, and Belleek ware.	Sanitary ware.	Porcelain electrical supplies.	Miscellaneous.[a]	Total.	Per cent of total.
20	Alabama						$34,245	0.12
23	Arkansas						20,088	.07
14	California			(b)		$41,854	95,213	.34
16	Colorado					14,834	48,995	.18
12	Connecticut				(c)	19,000	105,100	.38
27	District of Columbia						9,912	.04
	Florida						(d)	(d)
22	Georgia					500	22,390	.08
6	Illinois					22,250	943,007	3.38
7	Indiana			$496,000	(c)	50	932,147	3.34
15	Iowa					1,500	70,359	.25
	Kansas						(d)	(d)
11	Kentucky						157,083	.56
	Louisiana					(c)	(d)	(d)
	Maine						(d)	(d)
8	Maryland					4,017	364,358	1.30
9	Massachusetts					89,891	298,841	1.07
17	Michigan					7,000	45,961	.16
	Minnesota						(d)	(d)
24	Mississippi						15,580	.06
18	Missouri						43,368	.16
	Montana						(d)	(d)
	New Hampshire					(c)	(d)	(d)
2	New Jersey	$816,917	$129,000	3,426,291	$540,206	383,169	6,655,334	23.84
3	New York	(c)		(c)	617,663	109,222	1,627,730	5.83
25	North Carolina						13,319	.05
1	Ohio	(c)		(c)	879,207	1,121,500	13,024,071	46.65
	Oregon						(d)	(d)
4	Pennsylvania	(c)		(c)		700	1,346,431	4.82
21	South Carolina					200	28,838	.10
10	Tennessee					46,060	163,670	.59
13	Texas						100,788	.36
	Utah						(d)	(d)
	Virginia				(c)	(c)	(d)	(d)
19	Washington						41,100	.15
5	West Virginia			(c)	(c)	60,000	1,195,805	4.28
26	Wisconsin					500	12,450	.04
	Other States[e]	612,813		657,854	215,985	45,644	[f]502,711	1.80
	Total	1,429,730	129,000	4,580,145	2,253,061	1,967,891	27,918,894	100.00
	Per cent of pottery products	5.12	0.46	16.41	8.07	7.05	100.00	
	Per cent of total clay products	.95	.08	3.05	1.50	1.31	18.65	

[a] Including art and chemical pottery, bread toasters, chicken fountains, craquelle porcelain, faience, filter stones, Flemish ware, Hampshire pottery, jardinieres, pins, stilts, and spurs for potter's use, porcelain door knobs, shuttle eyes, thread guides and filter tubes, porcelain hardware trimmings, porcelain-lined cooking ware, tobacco pipes, toy marbles, turpentine cups, vases, and washboards.

[b] Sanitary ware for California included in California miscellaneous.

[c] Included in Other States.

[d] Included in *g* ($502,711).

[e] Includes all products made by less than three producers in one State. The total of other States is distributed among the States to which it belongs.

[f] Made up of State totals of Florida, Kansas, Louisiana, Maine, Minnesota, Montana, New Hampshire, Oregon, Utah, and Virginia.

Value of pottery products in 1904, by varieties of products, by States.

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	2,751,716	195,918
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	3,978,949	798,268

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)	4,670,480	$84,696
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		7,091,066	551,347
Grand total	756,625	3,411,025	290,819	$854,389	11,070,015	1,349,615
Per cent of total clay products	.58	2.60	.22	.65	8.45	1.03
Per cent of pottery products.	3.01	13.56	1.16	3.40	44.00	5.36

[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 in 1904, by varieties of products, by States—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.

Except earthenware and stoneware, pottery is produced in but few States. Yellow and Rockingham ware is produced in but 6 States, in only 1 of which were there three or more producers in 1905; C. C. ware was produced in only 7 States; white granite, etc., in only 7; china in but 4; bone china in but 1; and sanitary ware and porcelain electrical supplies in but 7. Where, however, there are less than three producers in any State, the total for that State is not given. This is done in order to prevent the disclosing of individual returns; hence some of these columns have figures for only one or two States, the others being grouped under "Other States."

Red earthenware is reported from 32 States, the largest producer being Massachusetts, reporting ware marketed to the value of $185,074. Pennsylvania was second, reporting ware valued at $149,786, and Ohio was third, with a product valued at $137,705. These 3 States produced earthenware to the value of $472,565, or 60.54 per cent of the total, which was $780,637. In 1904 this total was valued at $756,625. Red earthenware constituted 2.80 per cent of the pottery products and 0.52 of 1 per cent of the total clay products in 1905.

Stoneware, like red earthenware, is a widespread pottery product, 28 States reporting it in 1905, the total value being given as $3,708,817, or 13.28 per cent of the pottery products and 2.53 per cent of all clay products. In 1904 the stoneware product was valued at $3,411,025. Ohio was the largest producer of this ware in 1905, reporting a value of $1,310,302; Illinois was the next largest producer, with $864,507; and Pennsylvania was third, with $309,325. These 3 States reported $2,484,134, or 66.97 per cent of the total production.

Yellow and Rockingham ware, although made in 6 States, is reported by three or more producers in only 1, thus preventing the publication of State totals except in Ohio. This State reported ware to the value of $177,143, or 68.08 per cent of the total output.

Ohio, the only State for which the total can be given, reported C. C. ware valued at $609,478, or 72.69 per cent of the total, in 1905. This product was 3 per cent of the pottery products in 1905 and 0.56 of 1 per cent of all clay products.

Although the products grouped under white granite, semiporcelain, etc., are produced by no more States than C. C. ware, there are more States in which totals may be given. Ohio is again the leading State, reporting $8,521,944 worth of these varieties of pottery in 1905, or 71.19 per cent of the total, while New Jersey was second, reporting $1,288,926. These two States reported 81.96 per cent of the total. West Virginia was third, with products valued at $754,195. This product constituted 42.88 per cent of the pottery products in 1905 and 7.99 per cent of all clay products. In 1904 these figures were 44 and 8.45 per cent, respectively.

China is reported by 4 States, for only 1 of which can the total be given, namely, New Jersey, which reported ware valued at $816,917, or 57.14 per cent of the total. This product was 5.12 per cent of the pottery products and 0.95 of 1 per cent of all clay products in 1905. In 1904 these figures were, respectively, 5.36 and 1.03.

Bone china is reported from only 1 State, New Jersey, the entire product being reported as valued at $129,000.

Totals for 2 States are given for sanitary ware, Indiana and New Jersey, the latter reporting a product valued at $3,426,291, or 74.81 per cent of the entire product, and the former $496,000, or 10.83 per cent of the total, leaving only 14.36 per cent for the 5 States for which no total can be given. These States are California, New York, Ohio, Pennsylvania, and West Virginia. This product was 16.41 per cent of the pottery products and 3.05 per cent of all clay products in 1905. In 1904 these figures were, respectively, 14.25 and 2.74.

Porcelain electrical supplies are reported almost entirely from New Jersey, New York, and Ohio, these States reporting products valued at $2,037,076, or 90.41 per cent of the total output. Of the total, Ohio reported $879,207, or 39.02 per cent;

New York, $617,663, or 27.41 per cent, and New Jersey, $540,206, or 23.98 per cent. This product was 8.07 per cent of the pottery products and 1.50 per cent of all clay products in 1905. In 1904 these figures were, respectively, 5.69 and 1.09.

As in previous years, Ohio is the leading pottery-producing State, reporting products in 1905 valued at $13,024,071, or 46.65 per cent of the total. In 1904 the value of Ohio's products was $11,669,298, or 46.38 per cent of the product. This was a gain of $1,354,773, or 11.61 per cent. New Jersey was second, with a product valued at $6,655,334, or 23.84 per cent, as compared with $5,949,753, or 23.65 of the total, in 1904, a gain of $705,581, or 6.05 per cent. Pennsylvania, which was third in 1904, has been displaced by New York, the latter reporting products valued at $1,627,730, as compared with the former's $1,346,431. In 1904 these States reported: Pennsylvania, $1,399,882, and New York, $1,314,638. The 1905 figures show an increase for New York and a decline for Pennsylvania, owing probably to the cessation of some of the potteries in the western part of Pennsylvania. West Virginia maintains its same relative rank, fifth, though its product increased from $1,065,205, or 4.23 per cent of the total product, in 1904, to $1,195,805, or 4.28 per cent of the product, in 1905. There are no other changes in relative rank until tenth place is reached, Tennessee displacing Kentucky. Connecticut rose from fifteenth in 1904 to twelfth in 1905, Texas dropping from twelfth to thirteenth, California from thirteenth to fourteenth, and Missouri from fourteenth to eighteenth. There were no other changes of importance.

The following table shows the value of the pottery products by varieties, together with the number of producers reporting each variety, and the percentage of each variety, in 1904 and 1905:

Value of pottery products in the United States in 1904 and 1905, by varieties.

Variety.	1905.			1904.		
	Value.	Number of producers.	Percentage of pottery produced.	Value.	Number of producers.	Percentage of pottery produced.
Red earthenware	$780,637	187	2.80	$796,278	199	3.16
Stoneware	3,708,817	247	13.28	3,411,025	261	13.56
Yellow and Rockingham ware	260,199	16	.93	320,310	16	1.27
C. C. ware	1,225,639	13	4.39	955,704	12	3.80
White granite, semiporcelain, and semivitreous porcelain ware	11,970,975	70	42.88	11,070,015	72	44.00
China	1,429,730	9	5.12	1,589,725	11	6.32
Bone china, delft, and belleek ware	129,000	3	.46	162,500	5	.65
Sanitary ware	4,597,145	32	16.47	3,760,375	31	14.95
Porcelain electrical supplies	2,253,061	31	8.07	1,432,943	33	5.69
Miscellaneous[a]	1,563,691	70	5.60	1,659,395	67	6.60
Total	27,918,894	....	100.00	25,158,270	....	100.00

[a] Including art and chemical pottery, bread toasters, chicken fountains, craquelle porcelain, faïence, filter stones, Flemish ware, Hampshire pottery, jardinieres, pins, stilts and spurs for potters' use, porcelain door knobs, shuttle eyes, thread guides and filter tubes, porcelain hardware trimmings, porcelain-lined cooking ware, tobacco pipes, toy marbles, turpentine cups, vases, and wash boards, etc.

The figures given here in some varieties are not identical with those given in tables on previous pages. This is accounted for by the fact that in the former tables combinations were necessary in certain of the products to prevent disclosing individual returns. The figures given in this table, however, are accurate and represent the actual value of these varieties of pottery as reported to this office.

As in former years, the products reported under the head of white granite, etc., were of greatest value in 1905, being worth $11,970,975, or 42.88 per cent of all pottery products, and being reported by 70 producers; in 1904 these products, reported by 72 producers, were valued at $11,070,015, a gain for 1905 of $900,960, or 8.14 per cent. The product of next greatest value in both years was sanitary ware, being valued at $4,597,145 in 1905, or 16.47 per cent of the pottery products, as compared with $3,760,375, or 14.95 per cent of all pottery products in 1904. This is a gain of $836,770, or 22.25 per cent. This product was reported by 31 producers in 1904 and by 32 in 1905.

The stoneware industry, the third in value of output, increased its product from $3,411,025 in 1904 to $3,708,817 in 1905, an increase of $297,792, or 8.73 per cent. In spite of this increase the percentage of this product of the total decreased from 13.56 in 1904 to 13.28 in 1905. More producers reported this ware than any other, namely, 261 in 1904 and 247 in 1905.

Porcelain electrical supplies were marketed in 1905 to the value of $2,253,061, or 8.07 per cent of the total, as compared with $1,432,943, or 5.69 per cent, in 1904, a gain of $820,118, or 57.23 per cent. This is by far the largest proportional gain of any pottery product, and indicates that this is a growing branch of the industry.

The manufacture of china showed a falling off in 1905, and although a considerable product, valued at $1,429,730, was reported in 1905, yet the hopes of the lovers of fine ceramic ware, that this country would take its place among the large producers of fine china, do not seem likely to be realized in the immediate future. This ware was reported by 11 producers in 1904 and by 9 in 1905, and the product decreased from $1,589,725 in the former year to $1,429,730 in the latter, a decline of $159,995, or 10.06 per cent.

C. C. ware showed a gain in 1905 of $269,935, or 28.24 per cent, the figures being $955,704 for 1904, and $1,225,639 for 1905. In 1904 this product constituted 3.80 per cent of the total and 4.39 per cent of it in 1905. The number of producers increased one.

Red earthenware showed a decline from $796,278 in 1904 to $780,637 in 1905, while the number of producers reporting decreased from 199 to 187.

Yellow and Rockingham ware, which has been almost steadily declining for several years, showed another loss in 1905, falling from $320,310 in 1904 to $260,199 in 1905.

Exclusive of sanitary ware and porcelain electrical supplies, the total value of white ware marketed was $14,755,344 in 1905 as compared with $13,777,944, in 1904, a gain of $977,400, or 7.09 per cent. These wares include the products generally considered "pottery" by the public, such as the products used for domestic or household purposes, namely, tableware, toilet sets, etc. These products composed 52.85 per cent of all pottery products in 1905.

TRENTON, N. J., AND EAST LIVERPOOL, OHIO.

The pottery industry is scattered throughout many States, but the higher grades of ware are made in but few of them, and these are situated along the eastern seaboard and in the middle Western States. A brick plant or a plant to make the lower grades of pottery may be established almost anywhere that the material is found for the manufacture of these products, and generally the plants are established either at the clay bank or in very close proximity to it; but the manufacture of high-grade wares is so dependent on skilled labor that the plant must seek the labor. As the skilled labor necessary to make these products has developed in the regions mentioned, there we find the pottery centers of the country. The labor requirements explain why, at least in this country, the plants have developed at their present locations, though the plants may have been located, especially in the early history of the industry, in New Jersey as being most convenient to the source of supply of clay, which was England. It was thus that Trenton, N. J., and East Liverpool, Ohio, were developed into the leading pottery centers of the country.

The following table shows the value of the pottery products in Trenton, N. J., and East Liverpool, Ohio, in 1904 and 1905:

Value of pottery products of Trenton, N. J., and East Liverpool, Ohio, in 1904 and 1905, by varieties.

Variety.	1905.			1904.		
	Trenton.	East Liverpool.	Total.	Trenton.	East Liverpool.	Total.
Yellow and Rockingham ware	....	$83,060	$83,060	....	$77,230	$77,230
C. C. ware	(a)	(a)	(a)	$325,959	583,937	909,896
White granite, semiporcelain, and semivitreous porcelain ware	$1,288,926	4,721,810	6,010,736	1,284,199	3,919,511	5,203,710
China	816,917	....	816,917	816,374	(b)	816,374
Bone china, delft, and belleek ware	129,000	....	129,000	162,500	....	162,500
Sanitary ware	3,042,147	....	3,042,147	2,591,702	....	2,591,702
Porcelain electrical supplies	535,206	525,247	1,060,453	276,714	371,802	648,516
Miscellaneous [c]	357,637	656,484	1,014,121	83,270	324,150	407,420
Total	6,169,833	5,986,601	12,156,434	5,540,718	5,276,630	10,817,348
Per cent of total pottery product	22.10	21.44	43.54	22.02	20.98	43.00

[a] In order to prevent disclosing the operations of individual establishments, the value of C. C. ware for Trenton and East Liverpool is included in Trenton and East Liverpool miscellaneous, respectively.
[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 door and shutter knobs, etc.

This table shows again the remarkable equality in the value of the pottery products of these cities, there being even less difference in 1905 than in 1904, Trenton reporting wares valued at $6,169,833, or 22.10 per cent of the total pottery product, and East Liverpool reporting wares valued at $5,986,601, or 21.44 per cent of all pottery products. This is a difference of only $183,232, or 3.06 per cent, in favor of Trenton. In 1904 the difference was $264,088, or 5 per cent, in favor of Trenton. These corrected figures are slightly different from those published in the 1904 report. The greatest difference in value of the pottery products of these two cities since a comparison between them was begun by this office was in 1903, when it was $417,989, or 7.75 per cent, in favor of Trenton, the smallest difference being in 1901, when it was only $13,036.

Based on these figures, Trenton increased the value of its products from $5,540,718 in 1904 to $6,169,833 in 1905, a gain of $629,115, or 11.35 per cent, while East Liverpool's product increased in value from $5,276,630 in 1904 to $5,986,601 in 1905, a gain of $709,971, or 13.46 per cent. White granite ware, etc., appears to be East Liverpool's product of greatest value ($4,721,810, or 78.87 per cent of its total pottery product), while sanitary ware is Trenton's product of chief value ($3,042,147). Trenton reports no yellow or Rockingham ware, and East Liverpool reports no china, bone china, or sanitary ware. These two cities report together 43.54 per cent of all the pottery products of the country in 1905; 50.21 per cent of the entire white granite, etc.; 47.07 per cent of the porcelain electrical supplies, nearly equal quantities being produced in each place, and 64.85 per cent of the miscellaneous pottery products. Trenton alone reported 57.14 per cent of the china product of the entire country, all of the bone china, and 66.17 per cent of all of the sanitary ware produced in the country in 1905. Each of these cities marketed several times as much pottery as any State in the Union except, of course, the State in which each is located. Trenton reported in 1905 92.71 per cent of New Jersey's entire product, while East

Liverpool's product represents but 45.97 per cent of Ohio's total, these figures showing that, while practically all of New Jersey's pottery industry is centered at Trenton, Ohio's potteries are not at one place, but at several.

CONSUMPTION.

The pottery imports into the United States in 1905 were valued at $11,976,062 and the production at $27,918,894, a total of $39,894,956. After deducting the exports—domestic, $983,554, and foreign, $30,455—there appears to be a net consumption of $38,880,947, of which the domestic production was 71.81 per cent, the highest percentage reached except in 1902. In 1904 the domestic production was 70.66 per cent of the consumption and it was 70.56 per cent in 1903. In 1902, however, it was 72.91 per cent, which is the highest point reached since this office began publishing pottery statistics.

IMPORTS AND EXPORTS.

The following table gives the imports of clay products from 1901 to 1905, inclusive. It will be seen that the total value has increased steadily for several years, those for 1905 being the largest ever recorded, having risen from $11,488,411 in 1904 to $12,148,141 in 1905, an increase of 5.74 per cent. The increase of 1904 over 1903 was only $32,121, or 0.28 of 1 per cent.

Value of earthenware, china, brick, and tile imported and entered for consumption in the United States, 1901–1905.

Year.	Brown earthen and common stone ware.[a]	China and porcelain, not decorated.	China and porcelain, decorated.	Brick, fire brick, tile, etc.	Total.
1901	$51,551	$1,094,078	$8,385,514	$150,268	$9,681,411
1902	58,926	1,016,010	8,495,598	235,737	9,806,271
1903	95,890	1,234,223	9,897,588	228,589	11,456,290
1904	81,951	1,329,146	9,859,144	218,170	11,488,411
1905	100,618	1,157,573	10,717,871	172,079	12,148,141

[a] Including Rockingham ware.

It will be seen that these imports are nearly all pottery. Of the total in 1905, $11,976,062, or 98.58 per cent, was pottery, only $172,079, or 1.42 per cent, being brick and tile.

The following table shows the exports of clay products of domestic manufacture from the United States from 1901 to 1905, inclusive:

Exports of clay wares of domestic manufacture from the United States, 1901–1905.

Year.	Brick.				Pottery.			Grand total (value).
	Building.		Fire (value).	Total (value).	Earthen and stone ware (value).	China (value).	Total (value).	
	Quantity.	Value.						
	Thousands.							
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
1905	34,242	263,876	536,002	799,878	882,069	101,485	983,554	1,783,432

From this table it will be seen that the total value of exports of clay products increased from $1,379,124 in 1904 to $1,783,432 in 1905, the largest value in the period covered by the table, an increase of $404,308, or 29.32 per cent. Every item reached its maximum in 1905.

The brick exports increased from $587,385 in 1904 to $799,878 in 1905, a gain of $212,493, or 36.18 per cent. Of this increase, building brick contributed $84,010 and fire brick $128,483. The average value per thousand of building brick exported was $7.71 in 1905 and $7.19 in 1904.

The pottery exports increased from $791,739 in 1904 to $983,554 in 1905, a gain of $191,815, or 24.23 per cent. By far the larger part of these exports, 89.68 per cent, was earthenware and stoneware. For the first time the pottery exports approached the $1,000,000 mark.

CLAY PRODUCTS IN VARIOUS STATES.

The following tables give the statistics of the products of clay, by States, from 1901 to 1905, inclusive, for the more important clay-working States, and will be of interest to those who desire to compare the growth of the industries in these States for several years. Owing to the changes in the classification of the products in some of the minor items, the figures do not always represent the values of the products named, though the classification as given in the tables is the nearest that can be made without reconstructing the tables entirely.

CALIFORNIA.

Clay products of California, 1901–1905.

Product.	1901.	1902.	1903.	1904.	1905.
Brick:					
Common—					
Quantity	146,522,000	181,040,000	217,715,000	256,898,000	284,205,000
Value	$943,250	$1,291,941	$1,600,882	$1,843,936	$1,961,909
Average per M	$6.44	$7.14	$7.35	$7.18	$6.90
Front—					
Quantity	3,787,000	6,099,000	8,886,000	11,722,000	11,871,000
Value	$86,425	$119,302	$229,537	$291,813	$302,872
Average per M	$22.82	$19.56	$25.83	$24.89	$25.51
Vitrified—					
Quantity	(a)	....	(a)	(a)	(a)
Value	(a)	....	(a)	(a)	(a)
Average per M	$12.00	....	$15.00	$18.08	$19.23
Fancy or ornamental, value	$4,540	(a)	(a)	$27,037	$31,899
Fire value	$87,665	$96,491	$200,332	$285,718	$290,878
Stove lining do	(a)	$1,250	(b)	(a)	(a)
Draintile do	$50,156	$10,459	$17,994	$29,440	$27,852
Sewer pipe do	$285,599	$381,076	$411,380	$568,626	$663,044
Architectural terra cotta do	$141,380	$173,194	$180,488	$221,000	$215,160
Fireproofing do	$12,825	$18,645	$61,649	$51,125	$45,551
Tile, not drain do	(a)	(a)	(a)	(a)	$34,679
Pottery:					
Earthenware and stoneware value	$28,159	$40,012	$37,740	$45,005	$53,359
Sanitary ware do	(a)	(a)	(a)	....	(a)
Miscellaneous [c] do	$129,156	$120,726	$91,541	$261,034	$237,944
Total value	$1,769,155	$2,253,096	$2,831,543	$3,624,734	$3,865,147
Number of operating firms reporting	92	89	105	121	122
Rank of State	11	11	9	8	8

[a] Included in miscellaneous.
[b] Stove lining included in fire brick in 1903.
[c] Includes all products not otherwise classified, and those which could not be published separately without disclosing individual figures.

CONNECTICUT AND RHODE ISLAND.

Clay products of Connecticut and Rhode Island, 1901–1905.

Product.	1901.	1902.	1903.	1904.	1905.
Brick:					
Common—					
Quantity	160,696,000	156,885,000	158,382,000	186,908,000	211,613,000
Value	$822,079	$896,171	$890,989	$1,039,204	$1,329,220
Average per M	$5.12	$5.71	$5.62	$5.56	$6.28
Front—					
Quantity	(a)	(a)	(a)	3,060,000	(a)
Value	(a)	(a)	(a)	$45,730	(a)
Average per M	$15.04	$9.09	$15.04	$14.94	$14.01
Vitrified—					
Quantity	....	(a)	(a)	(a)	(a)
Value	....	(a)	(a)	(a)	(a)
Average per M	....	$9.10	$14.03	$14.00	$19.00
Fancy or ornamental, value	....	(a)	(a)	(a)	(a)
Fire ... value	(a)	(a)	$61,500	$43,500	(a)
Stove lining ... do	(a)	$12,750	(b)	(a)	(a)
Fireproofing ... do	(a)	(a)	(a)	....	....
Tile, not drain ... do	....	....	....	(a)	....
Pottery:[c]					
Earthenware and stoneware ... value	$48,200	$48,100	$42,250	(a)	(a)
Miscellaneous[d] ... do	$260,630	$260,657	$211,330	$87,175	$279,358
Total value	$1,130,909	$1,217,678	$1,206,069	$1,215,609	$1,608,578
Number of operating firms reporting	45	41	41	43	42
Rank of Connecticut and Rhode Island	21	21	23	23	20

[a] Included in miscellaneous.
[b] Stove lining included in fire brick in 1903.
[c] Produced by Connecticut alone.
[d] Includes all products not otherwise classified, and those which could not be published separately without disclosing individual figures.

GEORGIA.

Clay products of Georgia, 1901–1905.

Product.	1901.	1902.	1903.	1904.	1905.
Brick:					
Common—					
Quantity	222,111,000	223,705,000	257,844,000	269,815,000	275,841,000
Value	$1,182,553	$1,114,527	$1,305,896	$1,374,318	$1,444,479
Average per M	$5.32	$4.98	$5.06	$5.09	$5.24
Front—					
Quantity	5,325,000	5,150,000	2,915,000	3,924,000	2,667,000
Value	$55,700	$46,560	$25,748	$42,064	$28,676
Average per M	$10.46	$9.04	$8.83	$10.72	$10.75
Vitrified—					
Quantity	(a)	....	(a)	(a)	(a)
Value	(a)	....	(a)	(a)	(a)
Average per M	$7.69	....	$10.93	$12.00	$14.00
Fancy or ornamental, value	$12,200	(a)	$2,100	(a)	....
Fire.....value	$35,000	(a)	$73,600	$28,100	$73,050
Stove lining.....do	(a)	....	(b)	(a)	....
Draintile.....do	(a)	(a)	(a)	$8,099	$13,500
Sewer pipe.....do	$151,500	$174,008	$162,068	$165,068	$218,000
Architectural terra cotta.do	$71,800	$91,000	$85,500	(a)	(a)
Fireproofing.....do	(a)	$21,650	(a)	(a)	(a)
Tile, not drain.....do	(a)	....	....	(a)	(a)
Pottery:					
Earthenware and stoneware.....value	$16,410	$16,464	$21,942	$22,057	$21,890
Yellow and Rockingham ware.....value	(a)	(a)	....	....	....
Miscellaneous [c].....do	$19,920	$44,460	$54,168	$281,230	$320,151
Total value	$1,545,083	$1,508,669	$1,731,022	$1,920,936	$2,119,746
Number of operating firms reporting	107	103	99	103	95
Rank of State	16	19	15	12	12

[a] Included in miscellaneous.
[b] Stove lining included in fire brick in 1903.
[c] Includes all products not otherwise classified, and those which could not be published separately without disclosing individual figures.

ILLINOIS.

Clay products of Illinois, 1901–1905.

Product.	1901.	1902.	1903.	1904.	1905.
Brick:					
Common—					
Quantity	930,561,000	1,023,681,000	1,015,541,000	999,310,000	1,125,024,000
Value	$5,188,654	$5,131,621	$5,388,589	$5,167,165	$6,259,232
Average per M	$5.58	$5.01	$5.31	$5.17	$5.56
Front—					
Quantity	19,241,000	20,943,000	25,122,000	21,299,000	30,447,000
Value	$204,980	$240,466	$274,723	$251,762	$348,354
Average per M	$10.65	$11.48	$10.93	$11.82	$11.44
Vitrified—					
Quantity	99,572,000	91,116,000	96,568,000	121,073,000	90,563,000
Value	$899,454	$839,784	$1,015,710	$1,234,703	$973,247
Average per M	$9.03	$9.22	$10.52	$10.20	$10.75
Fancy or ornamental, value	$13,105	$11,893	$12,927	$11,733	$13,567
Fire ... value	$212,510	$199,048	$233,106	$217,008	$176,692
Draintile ... do	$694,588	$693,783	$892,807	$1,002,463	$1,051,852
Sewer pipe ... do	$348,716	$360,149	$532,858	$550,344	$580,538
Architectural terra cotta ... do	$812,015	$1,000,765	$1,198,477	(a)	(a)
Fireproofing ... do	$263,276	$358,015	$335,838	$324,264	$323,550
Tile, not drain ... do	$229,746	$257,049	$283,426	$194,471	(a)
Pottery:					
Earthenware and stoneware ... value	$598,549	$602,708	$694,770	$801,946	$889,857
Yellow and Rockingham ware ... value	(a)	(a)	(a)	(a)	(a)
C. C. and white granite ware ... value	...	$56,256	$168,363	...	...
Semivitreous porcelain ware ... value	(a)	(b)	(b)	...	...
Miscellaneous[c] ... do	$176,897	$130,303	$159,203	$1,021,588	$1,744,897
Total value	$9,642,490	$9,881,840	$11,190,797	$10,777,447	$12,361,786
Number of operating firms reporting	550	515	502	492	469
Rank of State	4	4	4	4	5

[a] Included in miscellaneous.
[b] Included in C. C. and white granite ware.
[c] Includes all products not otherwise classified and those which could not be published separately without disclosing individual figures.

INDIANA.

Clay products of Indiana, 1901–1905.

Product.	1901.	1902.	1903.	1904.	1905.
Brick:					
Common—					
Quantity	315,966,000	305,233,000	294,890,000	283,707,000	279,073,000
Value	$1,624,133	$1,710,385	$1,697,190	$1,677,714	$1,630,072
Average per M	$5.14	$5.60	$5.76	$5.91	$5.84
Front—					
Quantity	27,293,000	24,866,000	24,742,000	19,890,000	22,212,000
Value	$234,775	$215,202	$232,487	$197,890	$231,353
Average per M	$8.60	$8.65	$9.36	$9.95	$10.42
Vitrified—					
Quantity	31,468,000	45,933,000	47,864,000	51,859,000	43,573,000
Value	$320,221	$441,494	$482,967	$513,209	$474,600
Average per M	$10.18	$9.61	$10.09	$9.90	$10.89
Fancy or ornamental, value	$8,160	$10,398	(a)	(a)	$15,520
Fire ....value	$51,526	$66,725	$115,526	$130,216	$163,728
Stove lining ....do	(a)	....	(b)	(a)	(a)
Draintile ....do	$772,241	$807,516	$1,014,706	$1,205,717	$1,267,691
Sewer pipe ....do	$253,626	$311,223	$363,212	$294,000	$430,680
Architectural terra cotta..do	(a)	(a)	(a)	(a)	(a)
Fireproofing ....do	$91,081	$342,854	(a)	$210,800	$393,985
Tile, not drain ....do	$478,130	$579,896	$463,082	(a)	(a)
Pottery:					
Earthenware and stoneware ....value	$54,371	$28,780	$73,160	$65,390	$74,462
C. C. ware, white granite, semiporcelain and semivitreous porcelain ware, value	(a)	(a)	(a)	(a)	(a)
Sanitary ware ....value	(a)	(a)	(a)	$425,000	$496,000
Miscellaneous c ....do	$578,190	$769,260	$1,252,295	$1,182,653	$1,321,482
Total value	$4,466,454	$5,283,733	$5,694,625	$5,902.589	$6,499,573
Number of operating firms reporting	540	512	490	465	441
Rank of State	7	6	6	6	6

a Included in miscellaneous.
b Stove lining included in fire brick in 1903.
c Includes all products not otherwise classified and those which could not be published separately without disclosing individual figures.

IOWA.

Clay products of Iowa, 1901–1905.

Product.	1901.	1902.	1903.	1904.	1905.
Brick:					
Common—					
Quantity	249,318,000	228,142,000	191,323,000	207,041,000	193,259,000
Value	$1,611,040	$1,575,959	$1,355,129	$1,440,758	$1,366,653
Average per M	$6.46	$6.91	$7.08	$6.96	$7.07
Front—					
Quantity	8,785,000	7,504,000	12,815,000	7,994,000	5,676,000
Value	$88,164	$80,711	$135,849	$91,269	$60,669
Average per M	$10.04	$10.76	$10.60	$11.42	$10.69
Vitrified—					
Quantity	24,270,000	23,905,000	21,888,000	19,231,000	13,253,000
Value	$241,108	$232,056	$232,510	$199,528	$134,802
Average per M	$9.93	$9.71	$10.62	$10.38	$10.17
Fancy or ornamental, value	$2,229	$1,690	(a)	(a)	....
Fire .... value	$1,810	$850	$975	(a)	$869
Stove lining .... do	....	....	(b)	(a)	....
Draintile .... do	$534,935	$672,212	$1,028,383	$1,294,134	$1,509,226
Sewer pipe .... do	$54,500	(a)	(a)	(a)	(a)
Architectural terra cotta .... do	....	(a)	....	....	....
Fireproofing, terra-cotta lumber, and hollow building block or tile .... value	$59,270	$103,824	$131,191	$161,658	$137,554
Tile, not drain .... do	$11,903	$2,590	(a)	$4,300	(a)
Pottery:					
Earthenware and stoneware .... value	$26,200	$43,387	$52,922	$66,050	$68,859
Miscellaneous c .... do	$106,666	$130,057	$156,444	$203,156	$113,490
Total value	$2,737,825	$2,843,336	$3,093,403	$3,460,853	$3,392,122
Number of operating firms reporting	341	325	304	327	306
Rank of State	8	8	8	9	9

a Included in miscellaneous.
b Stove lining included in fire brick in 1903.
c Includes all products not otherwise classified and those which could not be published separately without disclosing individual figures.

KENTUCKY.

Clay products of Kentucky, 1901–1905.

Product.	1901.	1902.	1903.	1904.	1905.
Brick:					
Common—					
Quantity	115,977,000	112,728,000	123,309,000	138,677,000	147,702,000
Value	$621,756	$659,612	$689,403	$796,074	$862,330
Average per M	$5.36	$5.85	$5.59	$5.74	$5.84
Front—					
Quantity	2,486,000	6,172,000	6,869,000	2,178,000	11,558,000
Value	$16,535	$47,027	$53,769	$20,571	$128,777
Average per M	$6.65	$7.62	$7.83	$9.44	$11.14
Vitrified—					
Quantity	(a)	(a)	(a)	(a)	(a)
Value	(a)	(a)	(a)	(a)	(a)
Average per M	$12.71	$13.80	$15.20	$14.91	$14.27
Fancy or ornamental, value	(a)	....	....	....	....
Fire ....value..	$377,741	$605,448	$873,294	$680,084	$739,059
Stove lining ....do....	(a)	(a)	(b)	(a)	....
Draintile ....do....	$29,498	$26,039	$20,621	$26,564	$28,865
Sewer pipe ....do....	$100,705	(a)	(a)	(a)	(a)
Architectural terra cotta.do....	....	....	....	....	(a)
Fireproofing ....do....	(a)	....	(a)	(a)	....
Tile, not drain ....do....	(a)	$237,469	$222,420	(a)	$296,949
Pottery:					
Earthenware and stoneware ....value..	$139,697	$137,043	$139,827	$157,613	$157,083
Miscellaneous [c] ....do....	$228,611	$160,405	$191,625	$406,371	$193,287
Total value	$1,514,543	$1,873,043	$2,190,959	$2,087,277	$2,406,350
Number of operating firms reporting	117	111	113	120	121
Rank of State	18	15	11	10	10

[a] Included in miscellaneous.
[b] Stove lining included in fire brick in 1903.
[c] Includes all products not otherwise classified, and those which could not be published separately without disclosing individual figures.

MARYLAND.

Clay products of Maryland, 1901–1905.

Product.	1901.	1902.	1903.	1904.	1905.
Brick:					
Common—					
Quantity	113,457,000	141,235,000	147,663,000	160,279,000	210,446,000
Value	$676,708	$879,995	$976,969	$1,048,850	$1,423,663
Average per M	$5.96	$6.23	$6.62	$6.54	$6.76
Front—					
Quantity	5,772,000	3,457,000	2,728,000	2,245,000	1,426,000
Value	$76,792	$45,375	$40,479	$37,537	$24,118
Average per M	$13.30	$13.13	$14.84	$16.72	$16.91
Vitrified—					
Quantity	(a)	(a)	(a)	(a)	(a)
Value	(a)	(a)	(a)	(a)	(a)
Average per M	$15.00	$15.51	$9.46	$10.08	$17.96
Fancy or ornamental, value	$11,000	(a)	(a)	(a)	(a)
Fire ... value	$342,055	$277,290	$272,295	$235,136	$224,667
Stove lining ... do	$40,237	$21,540	(b)	(a)	$32,890
Draintile ... do	$2,402	$2,105	$1,355	$2,848	$4,703
Sewer pipe ... do	(a)	(a)	....	....	....
Architectural terra cotta ... do	(a)	(a)	(a)	(a)	(a)
Tile, not drain ... do	$16,586	(a)	(a)	(a)	(a)
Pottery:					
Earthenware and stoneware ... value	$13,374	$13,651	$16,428	$13,440	$13,325
Yellow and Rockingham ware ... value	(a)	(a)	(a)	(a)	(a)
C. C. and white granite semiporcelain and semivitreous porcelain ware, value	$176,637	$505,722	$450,000	$382,500	(a)
Miscellaneous [c] ... value	$249,864	$159,684	$151,295	$151,746	$526,001
Total value	$1,605,655	$1,905,362	$1,908,821	$1,872,057	$2,249,367
Number of operating firms reporting	66	68	59	63	68
Rank of State	13	13	14	13	11

[a] Included in miscellaneous.
[b] Stove lining included in fire brick in 1903.
[c] Includes all products not otherwise classified, and those which could not be published separately without disclosing individual figures.

MASSACHUSETTS.

Clay products of Massachusetts, 1901–1905.

Product.	1901.	1902.	1903.	1904.	1905.
Brick:					
Common—					
Quantity	170,455,000	241,376,000	190,812,000	165,435,000	194,504,000
Value	$1,060,493	$1,529,671	$1,236,103	$1,012,226	$1,264,787
Average per M	$6.22	$6.34	$6.48	$6.12	$6.50
Front—					
Quantity	6,950,000	3,631,000	2,625,000	(a)	2,080,000
Value	$98,892	$69,230	$52,450	(a)	$33,971
Average per M	$14.23	$19.07	$19.98	$21.67	$16.33
Vitrified—					
Quantity	....	....	....	(a)	....
Value	....	....	....	(a)	....
Average per M	....	....	....	$14.00	....
Fancy or ornamental, value	$63,040	(a)	(a)	(a)	(a)
Fire ....value..	$57,945	$54,342	$200,225	(a)	$68,180
Stove lining ....do....	$135,570	$133,752	(b)	(a)	$173,151
Architectural terra cotta.do....	(a)	(a)	(a)	(a)	(a)
Fireproofing ....do....	(a)	(a)	(a)	(a)	(a)
Tile, not drain..........do....	(a)	$67,418	(a)	$72,000	$82,000
Pottery:					
Earthenware and stoneware..........value..	$204,038	$206,808	$198,382	$193,633	$208,950
C. C. and white granite ware..........value..	(a)	(a)	(a)	(a)	(a)
Miscellaneous[c] ....do....	$250,859	$314,446	$421,525	$451,199	$219,418
Total value	$1,870,837	$2,375,667	$2,108,685	$1,729,058	$2,050,457
Number of operating firms reporting	90	90	86	87	78
Rank of State	10	10	12	16	13

[a] Included in miscellaneous.
[b] Stove lining included in fire brick in 1903.
[c] Includes all products not otherwise classified, and those which could not be published separately without disclosing individual figures.

MICHIGAN.

Clay products of Michigan, 1901–1905.

Product.	1901.	1902.	1903.	1904.	1905.
Brick:					
Common—					
Quantity	215,836,000	237,254,000	215,791,000	205,196,000	211,558,000
Value	$1,095,254	$1,331,752	$1,251,572	$1,116,714	$1,152,505
Average per M	$5.07	$5.61	$5.80	$5.44	$5.45
Front—					
Quantity	9,476,000	5,684,000	2,225,000	1,080,000	693,000
Value	$64,031	$42,792	$19,000	$7,500	$5,995
Average per M	$6.76	$7.53	$8.54	$6.94	$8.65
Vitrified—					
Quantity	(a)	(a)	(a)	(a)	6,112,000
Value	(a)	(a)	(a)	(a)	$81,706
Average per M	$12.30	$12.26	$13.27	$13.28	$13.37
Fancy or ornamental, value	(a)	(a)	(a)	(a)	....
Fire .... value	....	....	(a)	(a)	(a)
Stove lining .... do	(a)	....	(b)	(a)	(a)
Draintile .... do	$98,972	$96,645	$129,028	$208,088	$205,445
Sewer pipe .... do	(a)	(a)	(a)	(a)	(a)
Architectural terra cotta do	....	....	(a)	....	....
Fireproofing, terra cotta lumber, and hollow building tile or blocks .... value	$1,880	$3,290	$19,138	$8,080	(a)
Tile, not drain .... do	....	(a)	....	....	....
Pottery:					
Earthenware and stoneware .... value	$42,465	$44,098	$42,007	$40,621	(a)
Miscellaneous [c] .... do	$239,432	$225,463	$249,676	$333,510	$320,056
Total value	$1,542,034	$1,744,040	$1,710,421	$1,714,513	$1,765,707
Number of operating firms reporting	180	182	178	168	154
Rank of State	17	16	16	17	17

[a] Included in miscellaneous.
[b] Stove lining included in fire brick in 1903.
[c] Includes all products not otherwise classified and those which could not be published separately without disclosing individual figures.

MINNESOTA.

Clay products of Minnesota, 1901–1905.

Product.	1901.	1902.	1903.	1904.	1905.
Brick:					
Common—					
Quantity	157,727,000	192,674,000	161,911,000	164,154,000	166,233,000
Value	$852,303	$1,103,515	$982,728	$970,247	$977,837
Average per M	$5.40	$5.72	$6.07	$5.91	$5.88
Front—					
Quantity	5,506,000	6,280,000	6,922,000	6,566,000	6,636,000
Value	$55,016	$75,850	$78,930	$113,260	$85,300
Average per M	$9.99	$12.08	$11.40	$17.25	$12.85
Vitrified—					
Quantity	....	....	195,000	(a)	(a)
Value	....	....	$1,875	(a)	(a)
Average per M	....	....	$9.62	$10.00	$14.54
Fancy or ornamental, value	(a)	(a)	(a)	(a)	....
Fire value	(a)	(a)	....	....	(a)
Draintile do	$6,739	$2,219	$10,087	$11,100	$15,770
Sewer pipe do	(a)	(a)	(a)	(a)	(a)
Architectural terra cotta do	....	(a)	....	....	....
Fireproofing do	$35,700	$41,000	(a)	(a)	(a)
Tile, not drain do	(a)	(a)	....	....	....
Pottery:					
Earthenware and stoneware value	(a)	(a)	(b)	(b)	(b)
Miscellaneous [c] do	$598,889	$679,147	$453,388	$225,300	$420,479
Total value	$1,548,647	$1,901,731	$1,527,008	$1,319,907	$1,499,386
Number of operating firms reporting	116	111	116	114	111
Rank of State	15	15	18	21	21

[a] Included in miscellaneous.
[b] The value of pottery products for Minnesota for 1903, 1904, and 1905 could not be included in the State totals without disclosing the operations of individual establishments.
[c] Includes all products not otherwise classified and those which could not be published separately without disclosing individual figures.

MISSOURI.

Clay products of Missouri, 1901–1905.

Product.	1901.	1902.	1903.	1904.	1905.
Brick:					
Common—					
Quantity	276,821,000	292,134,000	274,755,000	271,370,000	316,002,000
Value	$1,595,031	$1,832,118	$1,725,253	$1,690,460	$2,028,957
Average per M	$5.76	$6.27	$6.28	$6.23	$6.42
Front—					
Quantity	26,301,000	30,744,000	26,153,000	25,599,000	28,224,000
Value	$298,158	$358,089	$333,965	$322,445	$362,996
Average per M	$11.34	$11.65	$12.77	$12.60	$12.86
Vitrified—					
Quantity	25,860,000	22,288,000	31,496,000	47,235,000	43,375,000
Value	$225,247	$194,250	$307,237	$480,671	$470,935
Average per M	$8.71	$8.72	$9.75	$10.17	$10.86
Fancy or ornamental, value	$62,108	$49,411	$39,756	$32,967	$44,632
Fire value	$620,116	$739,385	$925,915	$925,520	$1,117,209
Stove lining do	$9,520	(a)	(b)	(a)	(a)
Draintile do	$45,114	$35,887	$45,363	$80,479	$59,858
Sewer pipe do	$788,513	$903,279	$1,050,794	$1,176,679	$1,101,938
Architectural terra cotta do	$223,554	(a)	$371,006	(a)	(a)
Fireproofing, terra cotta lumber, and hollow building tile or blocks value	$59,043	$99,690	$98,888	(a)	(a)
Tile, not drain do	$60,202	$103,356	$235,091	(a)	(a)
Pottery:					
Earthenware and stoneware value	$62,647	$48,913	$50,001	$69,327	$43,368
Miscellaneous [c]	$425,300	$802,036	$478,338	$702,956	$973,518
Total value	$4,474,553	$5,166,414	$5,661,607	$5,481,504	$6,203,411
Number of operating firms reporting	259	235	242	232	224
Rank of State	6	7	7	7	7

[a] Included in miscellaneous.
[b] Stove lining included in fire brick in 1903.
[c] Includes all products not otherwise classified and those which could not be published separately without disclosing individual figures.

NEW JERSEY.

Clay products of New Jersey, 1901–1905.

Product.	1901.	1902.	1903.	1904.	1905.
Brick:					
Common—					
Quantity	351,886,000	300,583,000	272,178,000	319,975,000	465,040,000
Value	$1,675,746	$1,506,224	$1,500,295	$1,842,075	$3,090,809
Average per M	$4.76	$5.01	$5.51	$5.76	$6.65
Front—					
Quantity	29,239,000	42,926,000	41,075,000	47,058,000	53,770,000
Value	$473,138	$552,000	$548,553	$687,469	$852,744
Average per M	$16.18	$12.86	$13.35	$14.61	$15.86
Vitrified—					
Quantity	2,251,000	1,014,000	1,402,000	4,953,000	991,000
Value	$22,024	$10,437	$22,195	$66,813	$13,803
Average per M	$9.78	$10.29	$15.83	$13.49	$13.93
Fancy or ornamental, value	$11,514	$11,407	$14,970	(a)	$1,975
Enameled ....value..	(a)	(a)	(a)	(a)	(a)
Fire..........do....	$780,327	$819,580	$949,392	$908,882	$1,393,448
Stove lining ....do....	(a)	$8,477	(b)	(a)	(a)
Draintile..........do....	$22,612	$33,020	$20,825	$24,842	$24,315
Sewer pipe..........do....	(a)	(a)	(a)	$23,299	$56,576
Architectural terra cotta..do....	$920,664	$861,730	$1,364,094	$1,412,023	$1,614,263
Fireproofing, terra cotta lumber, and hollow building tile or blocks ....value..	$610,864	$965,047	$1,325,654	$1,211,646	$1,308,075
Tile, not drain..........do....	$486,122	$795,153	$734,159	$548,097	$585,130
Pottery:					
Earthenware and stoneware..........value..	$82,009	$59,820	$65,004	$70,819	$70,825
Yellow and Rockingham ware..........value..	(a)	(a)	(a)	....	....
C. C. ware..........do....	$443,455	$581,267	$454,029	$325,959	(a)
White granite ware..do....	$1,486,263	$1,431,270	$1,575,892	$1,284,199	$1,288,926
Semivitreous porcelain ware..........value..	$225,962				
China..........do....	$665,948	$680,368	$805,691	$816,374	$816,917
Bone china, delft, and belleek ware..........value..	$270,696	$90,840	$106,000	$162,500	$129,000
Sanitary ware..........do....	$2,244,904	$2,807,322	$2,794,984	$2,878,621	$3,426,291
Porcelain electrical supplies..........value..	$342,479	$358,496	$385,398	$302,293	$540,206
Miscellaneous [c]..........do....	$917,151	$1,040,805	$749,804	$738,136	$1,486,222
Total value..........	$11,681,878	$12,613,263	$13,416,939	$13,304,047	$16,699,525
Number of operating firms reporting	160	154	159	161	163
Rank of State	3	3	3	3	3

[a] Included in miscellaneous.
[b] Stove lining included in fire brick in 1903.
[c] Includes all products not otherwise classified, and those which could not be published separately without disclosing individual figures.

NEW YORK.

Clay products of New York, 1901–1905.

Product.	1901.	1902.	1903.	1904.	1905.
Brick:					
Common—					
Quantity	1,016,237,000	1,061,712,000	1,068,464,000	1,169,233,000	1,518,196,000
Value	$4,947,599	$5,021,132	$5,305,522	$6,783,528	$10,297,214
Average per M	$4.87	$4.73	$4.96	$5.80	$6.78
Front—					
Quantity	18,721,000	18,963,000	18,383,000	19,104,000	12,610,000
Value	$254,696	$249,573	$248,760	$263,150	$237,305
Average per M	$13.60	$13.16	$13.53	$13.77	$18.82
Vitrified—					
Quantity	29,950,000	27,009,000	16,797,000	14,490,000	12,076,000
Value	$343,343	$322,250	$220,296	$189,281	$149,391
Average per M	$11.46	$11.93	$13.11	$13.06	$12.37
Fancy or ornamental, value	(a)	....	(a)	(a)	(a)
Fire .... value	$293,944	$402,006	$629,245	$381,784	$427,873
Stove lining .... do	$115,054	$132,832	(b)	(a)	$133,383
Draintile .... do	$73,554	$110,301	$140,181	$139,876	$153,598
Sewer pipe .... do	$96,770	$209,105	$134,360	$125,510	(a)
Architectural terra cotta .... do	$754,911	(a)	$947,153	$785,978	$874,722
Fireproofing .... do	$98,947	$123,497	(a)	$132,034	$117,577
Tile, not drain .... do	$140,890	$125,680	$150,504	$154,417	$164,445
Pottery:					
Earthenware and stoneware .... value	$76,068	$86,708	$82,310	$74,781	$83,780
Yellow and Rockingham ware .... value	....	....	(a)	(a)	....
C. C. and white granite ware .... value	(a)	(a)	(a)	(a)	(a)
China .... do	$441,667	(a)	(a)	(a)	(a)
Sanitary ware .... do	(a)	(a)	(a)	(a)	(a)
Porcelain electrical supplies .... value	$310,214	$391,319	$474,842	$438,792	$617,663
Miscellaneous [c]	$344,061	$1,239,710	$875,079	$1,073,939	$1,229,396
Total value	$8,291,718	$8,414,113	$9,208,252	$10,543,070	$14,486,347
Number of operating firms reporting	276	262	242	240	249
Rank of State	5	5	5	5	4

[a] Included in miscellaneous.
[b] Stove lining included in fire brick in 1903.
[c] Includes all products not otherwise classified, and those which could not be published separately without disclosing individual figures.

OHIO.

Clay products of Ohio, 1901–1905.

Product.	1901.	1902.	1903.	1904.	1905.
Brick:					
Common—					
Quantity	489,275,000	538,552,000	497,071,000	455,936,000	514,419,000
Value	$2,725,512	$3,091,847	$3,002,506	$2,708,456	$3,033,435
Average per M	$5.57	$5.74	$6.04	$5.94	$5.90
Front—					
Quantity	69,405,000	63,815,000	50,997,000	65,645,000	89,390,000
Value	$612,718	$674,822	$633,101	$755,870	$1,074,007
Average per M	$8.83	$10.57	$12.41	$11.51	$12.01
Vitrified—					
Quantity	175,757,000	186,786,000	202,649,000	218,791,000	224,086,000
Value	$1,443,537	$1,643,532	$1,860,071	$2,222,931	$2,055,120
Average per M	$8.21	$8.80	$9.17	$10.16	$9.17
Fancy or ornamental, value	[a] $60,908	[a] $47,376	$42,522	$64,514	$18,153
Fire ....value	$1,287,059	$1,327,982	$1,561,936	$1,186,966	$1,427,919
Stove lining ....do	(b)	$192,460	(c)	(b)	$49,538
Draintile ....do	$707,409	$894,713	$1,149,990	$1,143,957	$1,291,323
Sewer pipe ....do	$2,735,703	$2,646,134	$3,295,635	$3,495,917	$3,550,160
Architectural terra cotta ..do	(b)	$18,289	(b)	....	....
Fireproofing, terra cotta lumber, and hollow building tile or blocks ....value	$357,284	$757,613	$865,649	$788,825	$923,762
Tile, not drain ....do	$996,005	$1,156,371	$1,072,103	$1,005,611	$1,188,460
Pottery:					
Earthenware and stoneware ....value	$952,329	$1,311,686	$1,225,735	$1,226,973	$1,448,007
Yellow and Rockingham ware ....value	$206,843	$129,591	$222,904	$231,994	$177,143
C. C. ware ....do	$726,321	$729,526	$762,475	$503,945	$609,478
White granite ware ..do	$2,710,726	$6,757,661	$6,681,080	$7,422,196	$8,521,944
Semivitreous porcelain ware ....value	$3,520,008				
China ....do	(b)	(b)	$265,300	$280,614	(b)
Sanitary ware ....do	(b)	(b)	(b)	(b)	(b)
Porcelain electrical supplies ....value	$325,664	$415,874	$486,740	$557,027	$879,207
Miscellaneous [d] ....do	$2,206,959	$2,454,271	[a] $2,080,381	[a] $2,051,987	[a] $2,055,383
Total value	$21,574,985	$24,249,748	$25,208,128	$25,647,783	$28,303,039
Number of operating firms reporting	813	801	815	819	792
Rank of State	1	1	1	1	1

[a] Enameled brick is included in fancy brick in 1901 and 1902; in miscellaneous in 1903, 1904, and 1905.
[b] Included in miscellaneous.
[c] Stove lining included in firebrick in 1903.
[d] Includes all products not otherwise classified, and those which could not be published separately without disclosing individual figures.

PENNSYLVANIA.

Clay products of Pennsylvania, 1901–1905.

Product.	1901.	1902.	1903.	1904.	1905.
Brick:					
Common—					
Quantity	875,631,000	949,718,000	927,212,000	856,963,000	1,036,777,000
Value	$5,357,079	$6,074,352	$6,174,437	$5,439,116	$6,532,814
Average per M	$6.12	$6.40	$6.66	$6.35	$6.30
Front—					
Quantity	70,207,000	77,746,000	80,177,000	75,407,000	131,368,000
Value	$844,087	$966,530	$1,050,805	$962,765	$1,683,031
Average per M	$12.02	$12.43	$13.11	$12.77	$12.81
Vitrified—					
Quantity	73,498,000	76,024,000	72,039,000	71,522,000	71,888,000
Value	$670,081	$716,887	$685,274	$766,638	$750,389
Average per M	$9.12	$9.43	$9.51	$10.72	$10.44
Fancy or ornamental, value	$74,726	$20,972	$32,602	$23,317	$37,966
Enameled ... value	(a)	(a)	(a)	(a)	(a)
Fire ... do	$4,791,083	$6,080,213	$6,537,076	$5,477,475	$5,771,795
Stove lining ... do	$86,190	$116,653	(b)	(a)	$180,353
Draintile ... do	$7,409	$9,317	$11,451	$8,646	$13,509
Sewer pipe ... do	$438,998	$550,481	$727,465	$834,646	$886,979
Architectural terra cotta ... do	$314,900	$243,800	$329,004	$349,317	$405,015
Fireproofing, terra cotta lumber, hollow building tile or blocks ... value	$101,652	$138,839	$278,621	$193,190	$352,107
Tile, not drain ... do	$188,525	$232,431	$207,608	$215,107	$310,931
Pottery:					
Earthenware and stoneware ... value	$431,433	$499,227	$533,535	$504,221	$459,111
Yellow and Rockingham ware ... value	(a)	(a)	(a)	(a)	(a)
C. C. ware ... do	...	(a)	...	(a)	...
White granite ware ... do	$839,903	$1,099,[illegible]11	$1,036,194	$707,809	$716,245
Sanitary ware ... do	(a)	$146,000	$144,414	(a)	(a)
Miscellaneous[c] ... do	$1,175,676	$938,712	$1,098,838	$1,339,616	$1,024,308
Total value	$15,321,742	$17,833,425	$18,847,324	$16,821,863	$19,124,553
Number of operating firms reporting	507	511	523	529	516
Rank of State	2	2	2	2	2

[a] Included in miscellaneous.
[b] Stove lining included in fire brick in 1903.
[c] Includes all products not otherwise classified, and those which could not be published separately without disclosing individual figures.

TEXAS.

Clay products of Texas, 1901–1905.

Product.	1901.	1902.	1903.	1904.	1905.
Brick:					
Common—					
Quantity	222,459,000	217,461,000	178,134,000	197,033,000	202,070,000
Value	$1,396,889	$1,353,489	$1,074,051	$1,157,130	$1,209,898
Average per M	$6.28	$6.22	$6.03	$5.87	$5.99
Front—					
Quantity	10,138,000	6,844,000	5,462,000	5,645,000	8,001,000
Value	$95,492	$73,619	$65,628	$58,734	$102,054
Average per M	$9.42	$10.76	$12.02	$10.40	$12.76
Vitrified—					
Quantity	(a)	(a)	(a)	(a)	(a)
Value	(a)	(a)	(a)	(a)	(a)
Average per M	$8.70	$9.23	$9.53	$8.81	$10.47
Fancy or ornamental, value	$1,339	$4,557	$11,240	$2,544	$18,127
Fire ... value	$23,337	$17,781	$22,333	$30,208	$14,724
Draintile ... do	$904	$2,766	(a)	(a)	....
Sewer pipe ... do	(a)	(a)	(a)	(a)	(a)
Tile, not drain ... do	$2,950	(a)	(a)	(a)	....
Pottery:					
Earthenware and stoneware ... value	$90,876	$96,402	$96,136	$106,471	$100,788
Miscellaneous [b] ... do	$111,588	$145,200	$203,192	$181,010	$273,354
Total value ... do	$1,723,375	$1,693,814	$1,472,580	$1,536,097	$1,718,945
Number of operating firms reporting	201	172	168	152	129
Rank of State	12	17	20	18	18

[a] Included in miscellaneous.
[b] Includes all products not otherwise classified, and those which could not be published separately without disclosing individual figures.

VIRGINIA.

Clay products of Virginia, 1901–1905.

Product.	1901.	1902.	1903.	1904.	1905.
Brick:					
Common—					
Quantity	171,624,000	192,337,000	189,891,000	203,484,000	237,161,000
Value	$1,139,894	$1,185,362	$1,245,861	$1,292,558	$1,572,442
Average per M	$6.64	$6.16	$6.56	$6.35	$6.63
Front—					
Quantity	17,650,000	20,433,000	18,866,000	21,077,000	22,155,000
Value	$267,028	$344,139	$303,431	$344,891	$352,297
Average per M	$15.13	$16.84	$16.08	$16.36	$15.90
Vitrified—					
Quantity	....	....	(a)	(a)	(a)
Value	....	....	(a)	(a)	(a)
Average per M	....	....	$8.92	$10.46	$10.80
Fancy or ornamental, value	$20,429	(a)	$27,330	$28,576	$20,363
Fire ....value	$3,971	(a)	(a)	(a)	(a)
Draintile..........do	$3,978	$4,240	$4,750	$5,673	$4,500
Pottery:					
Earthenware and stoneware..........value	(a)	(a)	(a)	(a)	....
Porcelain electrical supplies, value	....	....	....	(a)	(b)
Miscellaneous c..........value	$4,047	$44,092	$91,974	$64,694	$44,976
Total value	$1,439,347	$1,577,833	$1,673,346	$1,736,392	$1,994,578
Number of operating firms reporting	109	98	100	99	94
Rank of State	19	18	17	15	15

a Included in miscellaneous.
b The value of pottery products for Virginia for 1905 could not be included in the State total without disclosing individual figures.
c Includes all products not otherwise classified, and those which could not be published separately without disclosing individual figures.

WEST VIRGINIA.

Clay products of West Virginia, 1901–1905.

Product.	1901.	1902.	1903.	1904.	1905.
Brick:					
Common—					
Quantity	60,004,000	81,166,000	88,060,000	68,133,000	69,228,000
Value	$348,452	$527,661	$576,404	$469,501	$476,630
Average per M	$5.81	$6.50	$6.55	$6.89	$6.88
Front—					
Quantity	(a)	(a)	269,000	388,000	(a)
Value	(a)	(a)	$3,356	$5,380	(a)
Average per M	$7.12	$14.33	$12.48	$13.87	$16.67
Vitrified—					
Quantity	62,805,000	60,549,000	762,000	39,620,000	24,692,000
Value	$555,389	$578,777	$576,258	$470,339	$263,449
Average per M	$8.84	$9.56	$11.13	$11.87	$10.67
Fancy or ornamental, value	(a)	....	....	....	....
Fire..........value	$102,300	$23,633	$70,802	$11,814	$26,868
Stove lining	....	....	(b)	(a)	....
Draintile..........value	$1,485	$1,226	$1,499	$1,398	(a)
Sewer pipe..........do	(a)	(a)	(a)	(a)	(a)
Tile, not drain..........do	(a)	(a)	(a)	(a)	(a)
Pottery:					
Earthenware and stoneware..........value	$13,069	$15,018	$16,600	$18,923	$19,110
C. C. and white granite ware..........value	$419,873	$1,026,446	$1,099,900	$912,935	(a)
Semivitreous porcelain ware..........value	(a)	(c)			
Sanitary ware..........do	(a)	(a)	(a)	(a)	(a)
Miscellaneous[d]..........do	$505,912	$345,783	$213,741	$184,259	$1,232,738
Total value	$1,946,480	$2,518,544	$2,558,560	$2,074,549	$2,018,795
Number of operating firms reporting	53	53	56	64	62
Rank of State	9	9	10	11	14

a Included in miscellaneous.
b Stove lining included in fire brick in 1903.
c Included in white granite ware.
d Includes all products not otherwise classified, and those which could not be published separately without disclosing individual figures.

WISCONSIN.

Clay products of Wisconsin, 1901–1905.

Product.	1901.	1902.	1903.	1904.	1905.
Brick:					
Common—					
Quantity	187,173,000	152,127,000	181,722,000	186,292,000	186,531,000
Value	$1,151,838	$919,883	$1,193,360	$1,230,620	$1,260,066
Average per M	$6.15	$6.05	$6.57	$6.61	$6.76
Front—					
Quantity	6,527,000	7,724,000	6,794,000	8,438,000	4,917,000
Value	$54,379	$70,303	$62,857	$86,688	$49,275
Average per M	$8.33	$9.10	$9.25	$10.27	$10.02
Vitrified—					
Quantity	(a)	....	(a)	....	....
Value	(a)	....	(a)	....	....
Average per M	$7.50	....	$12.00	....	....
Fancy or ornamental, value	$2,105	(a)	(a)	(a)	$1,048
Fire ... value	(a)	(a)	....	....	....
Draintile ... do	$22,727	$17,763	$34,556	$54,831	$57,576
Tile, not drain ... do	(a)	(a)	....	....	....
Pottery:					
Earthenware and stoneware ... value	$12,400	$12,285	$13,586	$13,075	$11,950
Miscellaneous [b] ... do	$4,095	$6,424	$3,037	$5,780	$2,200
Total value	$1,247,544	$1,026,658	$1,307,396	$1,390,994	$1,382,115
Number of operating firms reporting	170	150	158	159	157
Rank of State	20	22	22	20	24

[a] Included in miscellaneous.
[b] Includes all products not otherwise classified, and those which could not be published separately without disclosing individual figures.

CLAY.

PRODUCTION.

The quantity of clay mined and sold by the miner as clay and not as a burned product is comparatively small, since in the vast majority of cases the miner is also the manufacturer. The most notable exceptions to this rule are the manufacturers of high-grade pottery and the paper makers, none of whom, so far as known to this office, mine their own clay. Stoneware and fire clay are mined by the manufacturers in some cases, and in others are shipped by the miners, while the varieties of clay used in other branches of the clay-working industries are almost exclusively burned by the miner.

The following tables include only the clay shipped by the miner, and, as far as possible, they represent the clay-mining industry in 1904 and 1905:

Clay mined and sold in the United States in 1905.

[Short tons.]

State.	Kaolin.		Paper clay.		Slip clay.		Ball clay.		Fire clay.		Stoneware clay.		Miscellaneous.[a]		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama									28,785	$19,443			27,580	$3,481	56,365	$22,924
Arizona[b]	13,724	$116,586	3,572	$28,932			(c)	(c)	12,432	33,736	825	$1,314	11,774	13,991	59,027	269,462
California									43,050	43,190	7,800	7,600			50,850	50,790
Colorado			(c)	(c)	(c)	(c)			9,390	14,090	(c)	(c)	28,447	24,319	41,317	42,669
Georgia			26,216	99,060					2,712	3,307	100	100			29,028	102,467
Illinois					(c)	(c)			50,922	53,726	48,075	40,221	(c)	(c)	127,728	120,410
Indiana									51,795	49,676	(c)	(c)	(c)	(c)	76,951	79,945
Kentucky							(c)	(c)	29,792	24,783	1,194	1,057	(c)	(c)	43,536	57,090
Maryland	(c)	(c)							8,370	12,830	(c)	(c)	300	300	12,080	24,405
Michigan					951	$3,354									951	3,354
Missouri	(c)	(c)							166,539	302,609	(c)	(c)			172,724	322,425
Montana									5,546	33,983					5,546	33,983
New Jersey							14,375	$23,287	313,067	426,399	37,717	67,572	75,486	99,201	440,645	616,459
New York					(c)	(c)			3,511	4,390	1,440	1,085	(c)	(c)	8,056	18,161
North Carolina	10,988	85,622							(c)	(c)	(c)	(c)			11,095	86,141
Ohio					(c)	(c)			184,139	154,155	41,344	54,252	13,655	8,315	239,718	217,302
Pennsylvania	17,000	96,303	7,006	39,206					194,539	250,515	4,459	4,223	12,506	16,141	235,510	406,388
South Carolina			39,145	139,190					(c)	(c)			5,600	4,600	45,595	146,790
Tennessee	(c)	(c)	(c)	(c)			18,170	38,775	42,662	46,612	4,932	4,362	1,167	1,452	67,531	94,201
West Virginia									81,489	52,530	(c)	(c)	(c)	(c)	81,880	52,640
Other States[d]	2,963	28,324	400	850	23,614	30,030	28,800	105,150	907	3,491	33,599	37,981	11,562	12,299	(e)	(e)
Total	44,675	326,835	76,339	307,238	24,565	33,384	61,345	167,212	1,229,647	1,529,468	181,485	219,767	188,077	184,102	1,806,133	2,768,006

[a] Including brick clay, cement shale, clay used for plaster and for boiler covering, modeling clay, sewer-pipe clay, siliceous clay, and terra-cotta clay.
[b] Including Connecticut, Delaware, Florida, Idaho, Iowa, Massachusetts, North Dakota, Oregon, South Dakota, Texas, Utah, Vermont, Virginia, Wisconsin, and Wyoming.
[c] Included in "Other States."
[d] Includes all products which could not be published separately without disclosing individual figures.
[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.

Clay mined and sold in the United States in 1904.

[Short tons.]

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.

[Short tons.]

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	18,330	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	193,0 0	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.

From these tables it will be seen that the clay mined in the United States in 1905 and sold as such was 1,806,133 short tons, valued at $2,768,006, as compared with 1,508,752 short tons, valued at $2,320,162, in 1904, a gain in quantity of 297,381 tons, or 19.71 per cent, and in value of $447,844, or 19.30 per cent.

New Jersey continues to be the leading clay-mining State, reporting 440,645 tons of clay marketed in 1905, valued at $616,459, or 22.27 per cent of the total, as compared with 415,850 tons, valued at $578,278, or 24.92 per cent of the total, in 1904, a gain in quantity of 24,795 tons, or 5.96 per cent, and of $38,181, or 6.60 per cent in value. Fire clay is New Jersey's principal clay, though that State reported smaller quantities of stoneware and ball clay.

Pennsylvania was second in value of product in 1905—$406,388, or 14.68 per cent of the total—though Ohio was second in quantity of clay mined and Pennsylvania third; the value of Pennsylvania's product increased from $323,624, or 13.95 per cent of the total, in 1904, to $406,388 in 1905, an increase of $82,764, or 25.57 per cent. Missouri was third in value of product, but fourth in quantity of clay mined; the value of its product in 1905 was $322,425, or 11.65 per cent of the total, as against $318,498, or 13.73 per cent of the total, in 1904, practically the same, while the quantity in 1905 fell off from the production of 1904.

Every State for which a total is given in the table increased in value, except New York, an unimportant clay-producing State, and South Carolina.

The following table shows the production and value of clay, by varieties, in 1904 and 1905:

Production and value of clay in the United States in 1904 and 1905, by varieties.

[Short tons.]

Variety.	1905.			1904.		
	Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.
Kaolin	44,675	$326,835	$7.32	41,207	$304,582	$7.39
Paper	76,339	307,238	4.02	70,505	276,381	3.92
Slip	24,565	33,384	1.36	3,937	11,942	3.03
Ball	61,345	167,212	2.73	46,181	142,028	3.08
Fire	1,229,647	1,529,468	1.24	1,068,598	1,306,053	1.22
Stoneware	181,485	219,767	1.21	86,304	83,904	.97
Miscellaneous	188,077	184,102	.98	192,020	195,272	1.02
Total	1,806,133	2,768,006	1.53	1,508,752	2,320,162	1.54

From this table it will be seen that every separate variety of clay showed an increase in 1905 over 1904. Kaolin increased its value $22,253, or 7.31 per cent; paper clay increased $30,857, or 11.16 per cent; slip clay made the largest proportional gain, rising from $11,942 in 1904 to $33,384 in 1905, a gain of $21,442, or 179.55 per cent; ball clay increased in value $25,184, or 17.73 per cent; fire clay, always an important item in the clay-mining industry, composing 55.26 per cent of the value of all clay in 1905, showed a gain of $223,415, or 17.11 per cent, over 1904; stoneware clay made a great gain in 1905, increasing in value $135,863, or 161.93 per cent, and in quantity 95,181 tons, or 110.29 per cent; the average price for all clay sold in 1905 was $1.53 and $1.54 in 1904.

IMPORTS.

The following table shows the imports of clay from 1901 to 1905, inclusive:

Classified imports of clay, 1901–1905.

[Long tons.]

Year.	Kaolin or china clay.		All other clays.						Total.	
			Unwrought.		Wrought.		Common blue.			
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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	142,898	891,708	22,680	123,241	1,217	25,026	4,699	50,364	171,494	1,090,339
1905	167,681	1,019,650	27,376	151,583	1,393	38,036	5,276	54,390	201,726	1,263,659

a Includes clay not otherwise provided for, valued at $822, but for which no quantity is reported.

LIME AND SAND-LIME BRICK.[a]

By E. C. Eckel.

INTRODUCTION.

For some years past statistics relative to the lime industry have been reported in the volume on Mineral Resources in the section on building stone, and the sand-lime brick production has been reported under the head of clay products. It seems desirable, in view of the growth of the lime and sand-lime brick industries, to give them a separate section in the volume.

LIME.

PRODUCTION.

The lime production of the United States in 1904 and 1905 is given in detail in the following table:

Quantity and value of lime burned in the United States in 1904 and 1905, by States.

[Short tons.]

State.	1904.			1905.		
	Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.
Alabama	73,700	$236,805	$3.21	79,973	$292,162	$3.65
Arizona	1,860	12,200	6.56	5,298	32,557	6.15
Arkansas	36,424	142,713	3.92	29,424	114,846	3.90
California	73,540	585,486	7.96	67,476	535,157	7.93
Colorado	7,789	34,360	4.41	10,115	48,459	4.79
Connecticut	47,241	168,107	3.56	70,558	261,509	3.71
Florida	9,072	55,085	6.07	10,719	63,950	5.97
Georgia	20,804	58,772	2.83	16,200	49,580	3.06
Idaho	4,983	40,142	8.06	6,694	44,733	6.68
Illinois	108,881	461,068	4.23	98,907	421,589	4.26
Indiana	100,703	349,499	3.47	106,408	366,866	3.45
Indian Territory	30	194	6.47	100	650	6.50
Iowa	28,789	91,008	3.16	19,360	76,904	3.97
Kansas	1,717	10,770	6.27	2,795	17,242	6.17
Kentucky	9,282	26,105	2.81	9,556	28,393	2.97
Maine	186,881	799,517	4.28	220,927	971,305	4.40
Maryland	116,934	309,079	2.64	134,431	360,247	2.68

[a] The tables on the production of lime and of sand-lime brick, respectively, were prepared by Miss A. T. Coons and Miss B. W. Bagley, of this office.—D. T. D.

Quantity and value of lime burned in the United States in 1904 and 1905, by States—Continued.

State.	1904.			1905.		
	Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.
Massachusetts	68,993	$322,141	$4.67	84,380	$395,326	$4.69
Michigan	63,601	256,955	4.04	48,089	192,844	4.01
Minnesota	17,982	73,763	4.10	18,977	81,093	4.27
Missouri	160,288	597,258	3.73	186,173	787,069	4.23
Montana	4,320	24,150	5.59	4,073	22,436	5.51
Nevada	150	2,700	18.00			
New Jersey	35,127	150,198	4.28	40,659	168,775	4.15
New Mexico	472	3,383	7.17	400	2,625	6.56
New York	88,189	396,281	4.49	114,876	490,845	4.27
North Carolina	920	4,800	5.22	1,792	7,980	4.45
Ohio	279,491	989,693	3.54	327,373	1,056,721	3.23
Oklahoma	300	3,000	10.00	400	4,000	10.00
Oregon	7,250	68,691	9.47	7,886	74,745	9.48
Pennsylvania	567,300	1,537,673	2.71	620,018	1,672,267	2.70
Rhode Island	4,553	31,871	7.00	6,461	42,743	6.62
South Carolina	7,302	32,859	4.50	7,955	34,440	4.33
South Dakota	3,700	23,960	6.48	4,165	26,308	6.32
Tennessee	60,779	217,064	3.57	75,667	252,908	3.34
Texas	35,318	141,500	4.01	31,984	142,470	4.45
Utah	19,000	85,500	4.50	12,765	69,089	5.41
Vermont	39,653	184,681	4.66	39,620	188,921	4.77
Virginia	82,133	277,519	3.38	114,221	396,434	3.47
Washington	41,626	216,454	5.20	27,935	160,985	5.76
West Virginia	100,539	255,786	2.54	104,156	255,337	2.45
Wisconsin	189,981	670,391	3.53	214,872	726,071	3.38
Wyoming	212	2,275	10.73	262	3,099	11.83
Total	2,707,809	9,951,456	3.68	2,984,100	10,941,680	3.67

This table for the production of lime in 1904 and 1905 does not include limestone sold mostly to sugar refineries, alkali plants, etc., and burned into lime by these purchasers for their own use. This class of material was valued at $613,649 in 1904 and at $408,548 in 1905. These values are for the unburned limestone. In the following table the value of such stone sold to lime burners is included with that of the lime production in 1904 and 1905.

Value of production of lime in the United States, 1896–1905.

1896	$6,327,900	1901	$8,204,054
1897	6,390,487	1902	9,335,618
1898	6,886,549	1903	9,255,882
1899	6,983,067	1904	[a]10,565,105
1900	6,797,496	1905	[a]11,350,228

[a] Includes lime burned by sugar refiners from limestone valued at $613,649 in 1904 and at $408,548 in 1905.

IMPORTS AND EXPORTS.

The imports of lime into the United States in 1905 were 22,247 short tons, valued at $84,564, as against 22,297 short tons, valued at $82,008, in 1904.

The exports in 1905 were valued at $76,658, as against $52,296 in 1904.

SAND-LIME BRICK.

The sand-lime brick produced in the United States during 1905 was valued at $972,064, as compared with $463,128 in 1904, an increase of practically 110 per cent.

Production of sand-lime brick in the United States in 1905, by States.

State.	Number of operating firms reporting.	Common brick.		Front brick.		Fancy brick.		Blocks, value.	Total value.
		Quantity.	Value.	Quantity.	Value.	Quantity.	Value.		
		Thousands.		*Thousands.*		*Thousands.*			
Alabama	3	1,552	$11,645	(a)	(a)	....	....	....	$23,727
Arizona, Colorado, Oregon, and Washington	5	725	5,947	1,281	$15,151	(a)	(a)	$121	21,289
Arkansas, Kansas, Minnesota, Nebraska, South Dakota, and Texas	9	20,425	133,784	2,490	30,480	....	....	....	164,264
California	5	4,215	32,534	(a)	(a)	(a)	(a)	....	34,689
Delaware, Maryland, New Jersey, and Virginia	7	12,401	80,639	587	7,237	(a)	(a)	....	88,876
Florida, Kentucky, Mississippi, South Carolina, and Tennessee	10	12,025	89,900	1,650	17,070	25	$500	....	107,470
Illinois and Wisconsin	4	4,451	25,524	350	2,875	....	....	....	28,399
Indiana	6	11,413	57,655	800	7,500	(a)	(a)	....	65,905
Iowa	3	3,974	28,793	(a)	(a)	(a)	(a)	1,384	38,652
Michigan	12	24,841	155,883	1,577	12,893	(a)	(a)	....	169,302
New York	7	11,841	81,804	3,478	41,300	....	....	....	123,104
North Carolina	3	3,185	20,953	660	8,150	....	....	....	29,103
Ohio	4	2,193	12,351	(a)	(a)	....	....	....	14,058
Pennsylvania	6	5,890	46,290	(a)	(a)	(a)	(a)	....	63,226
Other States[b]	....	....	....	3,689	39,863	173	3,838	....	(c)
Total	84	119,131	783,702	16,562	182,519	198	4,338	1,505	972,064
Average value per M	....	....	6.58	....	11.02	....	21.91	....	....

[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.

These figures may be compared with corresponding statistics for the preceding year, presented in the following table:

Production of sand-lime brick in the United States in 1904, by States.

State.	Number of operating firms reporting.	Common brick. Quantity.	Common brick. Value.	Front brick. Quantity.	Front brick. Value.	Fancy brick. Quantity.	Fancy brick. Value.	Total 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.

Value of production of sand-lime brick in the United States, 1903–1905.

Year.	Number of plants.	Value of products.
1903	16	$155,040
1904	57	463,128
1905	84	972,064

SAND AND GRAVEL.

By A. T. Coons.

INTRODUCTION.

In 1902 the first statistics of sand were compiled by this office, and included merely the sand and the sandstone crushed into sand used for glass manufacture. In the continued collection of these figures a large quantity of sand was reported used for other than glass-making purposes, and in 1904 the statistics of the sand used for molding were completed, and in this report the sand used in building operations has been more completely compiled, and gravel obtained in process of screening the sand for various uses, as well as gravel from the regular gravel pits, is included in the total statistics.

PRODUCTION.

The total production of sand and gravel reported to this office in 1905 was 23,174,967 short tons, valued at $11,199,645, an average value per ton of 48 cents, although the value varied from 6 and 8 cents to $6 per ton, according to the use to which the sand was put. The total given above included as follows:

Glass sand.—The glass sand, including sandstone ground into sand, produced in 1905 was 1,030,334 short tons, valued at $1,083,730; the figures for 1904 were 858,719 short tons, valued at $796,492, an increase in quantity of 171,615 short tons, and in value of $287,238. Sand for glass making is required to be purer than sand for any other purpose, with the consequence that glass sand is higher priced than other sands, the price and purity, however, depending upon the quality of glass desired.

Pennsylvania, Illinois, West Virginia, and Missouri supplied the larger quantity of glass sand in 1905, although Ohio, New Jersey, and Maryland contributed considerable quantities.

A report to the United States Geological Survey on the glass sand of the Missouri and Illinois regions has been made by Mr. E. F. Burchard, and a report on the West Virginia glass-sand region has been made by Mr. G. W. Stose.[a]

Molding sand.—In 1905 3,084,098 short tons of molding sand, valued at $2,102,423, were reported to the Survey. In 1904 these figures were 3,439,214 short tons, valued at $2,125,370, a decrease in 1905 of 355,116 short tons in quantity and of $22,947 in value. Molding sand includes core and pig bed sand as well as sand for steel, brass, and iron, and a small quantity of sand used for molding brick and pottery. The value of this sand varies greatly. Many small foundrymen who own small banks of sand find it capable of answering ordinary purposes, and the value of such sand is never estimated, since it amounts simply to the time and labor required to dig and haul the sand to the foundry. On the other hand, great care has to be taken in the selection of sand suitable for fine casting and for heavy castings.

Ohio, Pennsylvania, New York, New Jersey, and Illinois furnished the larger quantity of molding sand, the average value per ton, however, being greatest for the New York product.

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[a] Burchard, E. F., Bull. U. S. Geol. Survey No. 285, 1906, pp. 459–472; Stose, G. W., ibid., pp. 473–475.

A series of tests of representative molding sands has been made by the New Jersey Geological Survey.[a]

Building sand.—The output of building sand reported in 1904 was 4,501,467 short tons, valued at $1,783,749. In 1905, with a much more complete canvass, the production reported was 10,127,750 short tons, valued at $4,284,740. This includes the sand used for mortar and plaster as well as the sand used in making concrete structures, the demand for which has been exceptional during the past four or five years. New York, Pennsylvania, Missouri, Indiana, and Ohio were the largest producers of this material in 1905. For building sand a large quantity of sand is dredged from the Delaware, Mississippi, Ohio, Tennessee, and Potomac rivers and from the Great Lakes. A large quantity of beach sand also is used. These sands are washed, dried, and screened on board the dredges, and can be brought on boats to points of consumption at comparatively low price.

Fire, engine, and furnace sand.—Fire sand, engine sand, and furnace sand are varieties distinct in kind and in the uses to which sand is put, and each kind increased in quantity and value of output in 1905 as compared with 1904.

Other sand.—Under sand used for other purposes is included sand for grinding and cutting stone, for grinding and cutting glass, for use in filtration plants, for making a hard finish on woodwork, as a glaze on pottery and sanitary ware, as filling material for fireproof safes, for fireproofing, for crucibles, for strikers on match boxes, for sand paper, in sand-blast machines, and for many other purposes. Sand used in the manufacture of sand-lime brick is not included in these figures, nor the large quantity of sand used by railroads for filling and ballast, the value of which is exceedingly small.

Gravel.—Gravel used in concrete work, roadmaking, roofing, etc., was reported to this office in 1905 to the value of $1,800,657, which represented 4,422,856 short tons of material, the low average price being due to the fact that large quantities were used for ballast and filling on railroads and highways. Gravel as roofing material has an average price of 75 cents to $1 per ton. Gravel is in many cases a by-product of the sand industry, although it is mined extensively as the principal factor, the sand screened out being used for mortar and concrete.

The following tables show the quantity and value of sand and gravel produced in the United States in 1904 and 1905, by States and uses:

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[a] Kummel, H. B., and Hamilton, P. H., a report upon some molding sands of New Jersey: Ann. Rept. State Geologist New Jersey for 1904, pt. 4, pp. 189-246.

Production of sand and gravel in the United States in 1904 and 1905, by States.

[Short tons.]

1904

State.	Glass sand.		Molding sand.		Building sand.		Fire sand.		Engine sand.		Furnace sand.		Other sand.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama			88,675	$36,584	64,400	$16,615									153,075	$53,199
Arkansas			4,495	2,382	10,385	5,630			3,000	$1,500			1,620	$810	19,500	10,322
California	9,091	$11,614	6,150	4,600	1,591	1,736			19,339	4,733					36,171	22,683
Colorado			11,734	6,011	12,840	5,675					1,000	$850			25,574	12,536
Connecticut			2,002	4,325	9,360	2,250									11,362	6,575
Delaware			80	40							1,070	1,220			1,150	1,260
Georgia	3,600	3,600	73,386	30,463	11,245	4,149							150	150	88,381	38,362
Hawaii													2,895	8,708	2,895	8,708
Illinois	219,784	143,954	574,488	363,090	338,461	148,911	7,000	$2,200	8,250	2,120	37,360	17,551	21,328	11,914	1,206,671	689,740
Indiana	3,860	2,715	170,145	64,276	177,338	62,395							275,750	79,773	627,093	209,159
Iowa			6,224	4,877	3,761	1,745	31	25			31	25	120	90	10,167	6,762
Kentucky			386,330	222,542	211,290	78,675			7,750	4,400	10,000	6,400	16,980	11,500	632,350	323,517
Maryland	24,081	28,281	600	900	100,550	79,175	150	162	10,000	4,000			41,000	106,750	176,381	219,268
Massachusetts	8,292	16,590	12,960	7,060	44,717	24,289							5,550	13,125	71,519	61,064
Michigan			167,147	76,299	69,656	30,898									236,803	107,197
Minnesota			9,972	9,228	34,500	14,800									44,472	24,028
Mississippi			245	145	4,500	4,973									4,745	5,118
Missouri	121,629	68,503	57,835	31,519	1,352,427	425,982	6,200	3,015	93,750	22,500	10,400	4,900	290,847	95,190	1,933,083	651,609
New Jersey	51,850	36,284	263,811	161,032	312,680	119,846	74,237	46,865			1,716	429	44,948	12,006	749,242	376,462
New York	3,720	3,676	320,825	262,997	122,255	49,119	5,700	5,050	9,848	5,631	8,965	3,657	162,427	52,567	633,740	382,697
Ohio	43,930	32,061	484,090	377,187	234,730	84,937	21,652	15,429	25,372	12,870	44,642	41,165	12,718	10,787	867,134	574,436
Pennsylvania	294,333	346,370	628,064	369,381	740,111	279,880	58,251	57,275	70,667	53,521	11,788	9,261	334,524	164,906	2,137,738	1,280,594
Tennessee	80	160	20,468	13,186	98,975	86,125	125	30	6,472	3,045			1,200	600	127,320	103,146
Texas			9,958	6,783	148,000	67,800									157,958	74,583
Virginia			64,313	30,943	267,264	123,842			3,600	1,800			4,357	3,482	339,534	160,067
Washington			1,300	2,500											1,300	2,500
West Virginia	74,469	102,684	17,607	8,638	89,916	39,556			7,310	7,310			1,588	1,216	190,890	159,404
Wisconsin			53,585	26,478	39,333	24,200							92,750	129,000	185,668	179,678
Other States [a]			2,725	1,904	1,182	546							3,900	975	7,807	3,425
Total	858,719	796,492	3,439,214	2,125,370	4,501,467	1,783,749	173,346	130,051	265,358	123,430	126,972	85,458	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.

Production of sand and gravel in the United States in 1904 and 1905, by States—Continued.

1905

State.	Glass sand.		Molding sand.		Building sand.		Fire sand.		Engine sand.		Furnace sand.		Other sand.		Gravel.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama	162	$130	76,128	$32,096	66,512	$23,055			22,125	$8,100	6,925	$4,091	750	$300	25,502	$25,380	198,104	$93,152
Arkansas			58	41	97,431	37,244			13,500	5,600			6,250	2,500	5,125	5,100	122,364	50,485
California	9,257	8,122	290	496	1,798	2,679			22,681	5,690					116,867	54,120	150,893	71,107
Colorado	1,500	1,875	4,698	2,005	4,710	2,700	4,812	$2,890	500	175			1,250	1,000	5,325	4,100	22,795	14,745
Connecticut			1,696	3,598	10,000	3,000							1,125	360			12,821	6,958
Delaware			200	100	110,124	44,049			28,078	11,231	22,479	9,801					160,881	65,181
Georgia	4,500	4,050	14,145	7,789	62,573	27,436			625	250			3,160	1,728			85,003	41,253
Hawaii					2,560	4,914									5,016	5,039	7,576	9,953
Illinois	234,391	146,605	336,247	189,423	244,297	111,212	2,546	908	4,062	1,425	10,761	4,404	518,049	112,761	277,050	127,034	1,627,403	693,772
Indiana	1,640	2,169	145,207	69,524	689,451	442,836			32,300	8,425	54,525	9,112	1,769,092	390,736	457,968	318,548	3,150,183	1,241,350
Iowa			2,654	2,861	191,688	69,964	2,215	900	277	77			112,581	9,107	16,467	9,378	325,882	92,287
Kansas					70,988	21,552											70,988	21,552
Kentucky	739	480	64,994	49,153	193,872	95,647	2,050	1,600	11,875	8,150	2,000	2,000	42,192	10,008	410,148	115,906	727,870	282,944
Louisiana					139,157	73,991			2,500	500			12,167	3,156	196,845	112,315	350,669	189,962
Maryland	17,899	20,108			172,289	86,759							164,592	255,071	110,397	74,890	465,177	436,828
Massachusetts	4,600	12,000	10,815	8,649	86,690	50,275	10,000	6,500	200	130	2,000	2,000	11,755	9,410	58,962	41,122	185,022	130,086
Michigan			19,382	13,247	263,315	148,065	5,000	2,500					50,187	14,476	76,625	32,321	414,509	210,609
Minnesota			13,854	12,452	59,405	29,230							3,130	2,580	33,187	27,113	109,576	71,375
Mississippi			70	35	6,250	2,000											6,320	2,035
Missouri	123,467	66,401	50,315	32,637	1,367,132	466,105	9,232	4,668	75,000	12,000	13,540	6,875	104,062	43,565	342,592	102,303	2,085,340	734,554
Nebraska					12,900	8,200											12,900	8,200
New Jersey	35,673	30,005	347,810	223,474	425,518	172,152	100,888	121,802	37,000	13,796	31,544	13,213	135,036	149,378	159,074	55,529	1,272,543	779,349
New York	3,165	3,115	503,307	457,375	2,644,834	1,019,786	27,500	27,500	19,747	8,386	4,394	2,016	49,858	29,606	337,950	158,762	3,590,755	1,706,546
Ohio	76,460	79,999	666,914	496,937	619,402	224,134	7,311	4,860	12,469	7,137	130,308	93,364	91,037	40,027	677,938	167,304	2,281,839	1,113,762
Pennsylvania	361,829	482,937	656,034	396,741	1,689,100	730,946	31,547	31,266	124,519	90,208	43,947	24,524	288,023	207,128	833,805	272,559	4,028,804	2,236,309
Tennessee			36,636	20,843	203,525	70,284	1,562	1,275	26,210	13,378	16,891	6,628	17,405	9,604	112,249	35,582	414,478	157,594
Texas			5,087	2,721	270,853	123,174			5,825	770			6,000	2,640	75,320	17,157	363,085	146,462
Vermont			700	325	3,265	1,285							82,250	8,800	312	125	86,527	10,535
Virginia			61,246	37,899	244,572	96,248	810	405	4,775	3,580	4,212	2,665	250	330	35,250	13,453	351,115	154,580
West Virginia	155,052	225,734	9,584	7,403	77,488	42,232			33,503	28,536	3,142	1,156	4,631	3,070	6,701	3,764	290,101	311,895
Wisconsin			52,279	27,412	84,573	47,279					75	75	2,450	3,132	42,569	18,390	181,946	96,288
Other States[a]			3,748	7,187	11,478	6,307							2,660	1,080	3,612	3,363	21,498	17,937
Total	1,030,334	1,083,730	3,084,098	2,102,423	10,127,750	4,284,740	205,473	207,074	477,771	227,544	346,743	181,924	3,479,942	1,311,553	4,422,856	1,800,657	23,174,967	11,199,645

[a] Includes Florida, Maine, North Carolina, Oklahoma, South Carolina, Utah, Washington, and Wyoming.

IMPORTS.

Sand valued at $48,710 was imported into United States in 1905, as compared with imports valued at $55,312 in 1904, a decrease of $6,602 in 1905.

SLATE.[a]

PRODUCTION.

Of the five years from 1901 to 1905 the year 1903 shows the greatest value for the slate output in the United States. For some years previous to 1903 there was a steady increase in the slate production owing to general activity in building trades and to the large quantities of slate exported to Great Britain because of a protracted strike in the Welsh quarry district. In 1903 the increase of the slate output in this country, especially of roofing slate, was checked by labor troubles in the building trades, by decreased export trade due to partial settlement of the strikes in Wales, and to the importation into English markets of small sizes of cheaper French roofing slates. These same causes produced a continued decrease of the output in both 1904 and 1905, although there is but a small difference in the total values for the two years, these figures being $5,617,195 in 1904, and $5,496,207 in 1905, a decrease of $120,988 in 1905.

Mill stock used for manufacture into blackboards, table tops, mantels, electrical supplies, school slates, pencils, etc., decreased from $947,906 in value in 1904 to $921,657 in 1905, a loss of $26,249.

Roofing slate decreased in value from $4,669,289 in 1904 to $4,574,550 in 1905, or $94,739. There was, however, an increase in the number of squares from 1,233,757 in 1904 to 1,241,227 in 1905, or 7,470 squares, the result of the increased demand for the smaller sizes of slate.

The average price per square rose 14 cents from $3.01 in 1900 to $3.15 in 1901; rose again 30 cents to $3.45 in 1902; rose again 43 cents to $3.88 in 1903; fell 10 cents to $3.78 in 1904, and fell again 9 cents to $3.69 in 1905. The prices by sizes are given in detail in a subsequent table.

The States having the largest output, Pennsylvania and Vermont, showed the greatest decrease in value. Of the other States, California, Georgia, Maine, Maryland, and Virginia increased, and New York and Arkansas decreased in value of output. New Jersey having no production in 1904, reported an output in 1905, and Tennessee and Utah, having small outputs in 1904, reported no operations in 1905.

A very complete and detailed description of the slate deposits of the United States, by Mr. T. Nelson Dale, of the United States Geological Survey, is now in course of publication.[b]

[a] Credit for the report on slate should be given to Miss Altha T. Coons, statistical expert of this office.—D. T. D.

[b] Dale, T. Nelson, Slate deposits and slate industry of the United States: Bull. U. S. Geol. Survey No. 275, 1906.

The following table shows the value of roofing and milled slate quarried in the United States in 1904 and 1905, by States:

Value of roofing and mill slate produced in the United States in 1904 and 1905, by States.

1904.

State.	Roofing slate.		Value of milled stock.	Total value.
	Number of squares.	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 Jersey	....	....	....	....
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

1905.

State.	Number of squares.	Value.	Value of milled stock.	Total value.
Arkansas	50	$350	$9,650	$10,000
California	5,000	40,000	....	40,000
Georgia	1,500	7,500	....	7,500
Maine	19,865	106,271	117,983	224,254
Maryland	25,845	149,315	1,900	151,215
New Jersey	1,340	5,360	....	5,360
New York	10,354	65,051	1,595	66,646
Pennsylvania	802,170	2,879,671	612,234	3,491,905
Tennessee	....	....	....	....
Utah	....	....	....	....
Vermont	339,001	1,174,246	178,295	1,352,541
Virginia	36,102	146,786	....	146,786
Total	1,241,227	4,574,550	921,657	5,496,207

The following table shows the average value of roofing slate per square since 1900:

Average annual price per square of roofing slate for the entire country.

1900	$3.01	1903	$3.88
1901	3.15	1904	3.78
1902	3.45	1905	3.69

The following table shows the total value of the slate production of the United States from 1901 to 1905, inclusive:

Value of slate produced in the United States, 1901–1905, by States.

State.	1901.	1902.	1903.	1904.	1905.
Arkansas	....	$4,000	$4,709	$14,300	$10,000
California	$18,608	31,500	70,000	39,200	40,000
Georgia	3,000	4,000	....	4,500	7,500
Maine	202,325	206,558	231,230	181,168	224,254
Maryland	105,798	118,084	137,631	133,972	151,215
Minnesota	1,400	....	....	....	....
New Jersey	30,000	32,000	33,403	....	5,360
New York	100,960	126,718	111,998	71,543	66,646
Pennsylvania	2,984,264	3,547,322	3,959,906	3,633,246	3,491,905
Tennessee	....	....	....	607	....
Utah	....	....	....	300	....
Vermont	1,162,191	1,464,918	1,592,652	1,408,151	1,352,541
Virginia	178,979	160,951	115,356	130,208	146,786
Total	4,787,525	5,696,051	6,256,885	5,617,195	5,496,207

The following table shows the price per square at the beginning of 1905 and 1906 of the various kinds of No. 1 slate. The figures have been compiled from information sent in by the producers and represent the value free on board at the quarry. The figures are of especial interest and value at this time, as the comparison which they present for the two years 1905 and 1906 indicates a transition stage in the history of the industry, many localities showing a decrease in the price of slate ranging from 25 to 50 cents per square.

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.

Price per square by sizes of various kinds

Number per square.	Size.	January 1, 1905. Monson, Me., No. 1.	New York red.	Maryland and Pennsylvania Peach Bottom.	Pennsylvania. Bangor No. 1.	Bangor ribbon No. 1.	Albion No. 1.	Pen Argyl.	Hard vein.	Danielsville.	Chapman.	Slatington unfading big bed.	Vermont. Unfading green.	Sea green.	Intermediate sea green.	Purple vein.	Virginia.
	Inch.																
686	9×7	$3.50	$6.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
588	10×7	.....	6.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	$4.00	.....	.....	.....	.....
515	10×8	4.00	6.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	4.00	.....	.....	.....	.....
450	11×8	4.50	8.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
534	12×6	4.50	8.50	.....	$4.50	.....	$4.25	$4.00	$3.50	.....	.....	$3.25	4.50 4.00	$2.50	.....	$2.50	.....
458	12×7	5.00	9.00	.....	4.50	.....	4.25	4.25	3.50	.....	.....	.....	4.50 4.00	2.50	.....	.....	.....
400	12×8	5.50	9.00	.....	4.50	$4.25	4.25	4.25	.....	.....	.....	3.75	4.50 4.00	3.25	.....	.....	.....
356	12×9	5.60	9.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	4.50 4.00	3.25	.....	3.25	.....
320	12×10	5.80	9.00	.....	4.50	.....	.....	.....	.....	.....	.....	.....	4.50	3.25	.....	3.25	.....
267	12×12	.....	.....	.....	6.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
374	14×7	6.40	10.50	$6.00	4.75	4.25	4.50	4.25	4.50	.....	.....	4.25	5.25	3.25	.....	3.25	.....
328	14×8	6.60	10.50	6.00	4.75	4.25	4.50	4.25	4.50	.....	.....	4.25	5.25	3.50	$2.60	3.50	.....
291	14×9	6.50	10.50	6.25	.....	.....	.....	.....	.....	.....	.....	4.25	5.25	3.50	2.60	3.50	.....
262	14×10	6.60	10.50	6.25	4.75	4.25	4.50	4.50	.....	.....	.....	4.25	5.25	3.50	2.60	3.50	.....
219	14×12	6.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3.50	2.60	3.50	.....
187	14×14	.....	10.50	.....	6.00	.....	5.50	.....	.....	.....	.....	4.75 4.50	.....	.....	.....	.....	.....
277	16×8	7.20	10.50	6.35	5.75	4.25	5.00	4.75	4.50	$4.25	$5.25	.....	5.25 4.50	3.50	2.90	3.50	$5.00 5.50
247	16×9	7.00	10.50	6.35	5.25	.....	5.00	4.75	4.50	.....	.....	4.75	5.25	3.50	2.90	3.50	.....
222	16×10	7.10	10.50	6.35	5.25	4.25	5.00	4.75	.....	.....	.....	4.75	5.25	3.70	2.90	.....	.....
202	16×11	6.90	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
185	16×12	6.80	.....	.....	4.50	4.00	4.25	4.50	.....	.....	.....	.....	5.25	3.70	2.90	.....	.....
139	16×16	.....	10.50	.....	6.00	.....	5.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
214	18×9	7.10	10.50	6.35	5.75	4.25	5.00	4.75	4.50	.....	.....	.....	5.25	3.70	2.90	3.70	.....
192	18×10	7.20	10.50	6.35	5.25	4.25	5.00	4.75	4.50	.....	.....	4.75	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	.....	.....	.....	.....	5.25	3.70	2.90	3.70	.....
...	18×18	.....	.....	.....	6.00	.....	5.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
170	20×10	6.80	10.50	6.35	5.25	4.00	5.00	4.75	4.50	.....	.....	4.75	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	.....	3.70	2.90	.....	.....
138	22×11	6.50	.....	6.25	4.75	4.00	4.50	4.50	4.25	.....	.....	4.50	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	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	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	3.80	2.90	3.20	.....
86	26×14	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4.00	.....	4.00	.....
...	28×14	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4.00	.....	4.00	.....

of No. 1 slate free on board at quarry.

January 1, 1906.														
			Pennsylvania.							Vermont.				
Monson, Me., No. 1.	New York red.	Maryland and Pennsylvania Peach Bottom.	Bangor No. 1.	Bangor ribbon No. 1.	Albion No. 1.	Pen Argyl.	Danielsville.	Chapman.	Slatington unfading big bed.	Unfading green.	Sea green.	Intermediate sea green.	Purple vein.	Virginia.
$3.50	......	......	......	......	......	......	......	......	......	......	......	......	......	......
......	$6.50	......	......	......	......	......	$3.50	......	......	$3.50	......	......	$3.50	......
4.00	6.50	......	......	......	......	......	3.50	......	......	3.50	......	......	3.50	......
4.50	......	$4.00	......	......	......	......	......	......	......	......	......	......	......	......
4.50	8.50	5.00	$4.00	......	$3.75	$3.25	3.50	$4.25	$3.50	4.00	$2.75	......	4.00	$4.15
5.00	8.50	5.25	4.00	......	3.75	3.25	3.50	4.25	3.75	4.00	2.75	......	4.00	4.15
5.50	8.50	5.25	4.00	$3.50	3.75	3.25	3.50	......	4.00	4.00	3.35	......	4.00	4.65
5.60	8.50	5.25	......	......	......	......	......	......	......	4.00	3.35	......	4.00	4.65
5.80	8.50	5.25	4.00	......	......	......	......	......	......	4.00	3.35	......	4.00	......
......	......	......	6.00	......	......	......	......	......	......	......	3.45	......	......	......
6.40	10.00	6.00	4.25	3.75	4.00	3.25	3.50	4.60	4.25	5.25	3.35	......	5.25	5.15
6.60	10.00	6.00	4.50	3.75	4.25	3.25	3.50	4.75	......	5.25	3.45	$2.35	5.25	5.15
6.50	10.00	6.25	......	......	......	......	......	......	......	5.25	3.45	2.35	5.25	5.15
6.60	10.00	6.25	4.25	3.75	4.00	3.50	3.50	......	4.50	5.25	3.45	2.35	5.25	5.15
6.50	10.00	......	......	......	......	......	3.50	......	......	5.25	3.45	2.35	5.25	......
......	......	......	6.00	......	5.50	......	......	......	......	......	3.45	......	......	......
7.20	10.25	6.35	4.50	4.00	4.25	3.75	3.75	5.00	4.50	5.25	3.45	2.35	5.25	5.75
7.00	10.25	6.35	4.50	......	4.25	3.75	3.75	5.00	4.50	......	3.45	2.35	......	5.65
7.10	10.25	6.35	4.50	4.00	4.25	3.75	3.75	......	4.50	5.25	3.45	2.35	5.25	5.65
6.90	......	......	......	......	......	......	......	......	......	5.25	......	......	5.25	......
6.80	10.25	......	4.25	3.75	4.00	3.50	3.75	......	......	5.25	3.45	2.35	5.25	......
......	......	......	6.00	......	5.50	......	......	......	......	......	......	......	......	......
7.10	10.00	6.35	4.50	4.00	4.25	3.75	3.75	5.00	4.50	5.25	3.45	2.60	5.25	5.75
7.20	10.00	6.35	4.50	4.00	4.25	3.75	3.75	5.00	4.50	5.25	3.45	2.60	5.25	5.75
7.00	10.00	6.25	......	......	......	......	......	......	......	5.25	3.45	2.60	5.25	5.30
6.80	10.00	6.25	4.25	3.75	4.00	3.50	3.75	......	......	5.25	3.45	2.60	5.25	5.15
......	......	......	6.00	......	5.50	......	......	......	......	......	......	......	......	......
6.80	10.00	6.35	4.50	4.00	4.25	3.75	3.50	5.00	4.50	5.25	3.45	2.60	5.25	5.75
6.80	10.00	6.25	......	......	......	......	......	5.00	......	5.25	3.45	2.60	5.25	5.30
......	10.00	6.25	4.25	3.75	4.00	3.50	3.50	......	......	5.25	3.45	2.60	5.25	5.15
6.90	10.00	......	......	......	......	......	......	......	......	5.25	3.45	2.60	5.25	......
6.50	10.00	6.25	4.25	3.75	4.00	3.50	3.50	4.75	4.25	5.00	3.45	2.60	5.00	5.30
6.60	10.00	6.25	4.25	3.75	4.00	3.50	3.50	4.75	4.25	5.00	3.45	2.60	5.00	5.15
6.60	10.00	......	......	......	......	......	......	......	......	5.00	3.45	2.60	5.00	5.05
6.60	10.00	6.25	4.25	3.75	4.00	3.50	3.50	4.50	4.25	4.75	3.45	2.60	4.75	5.15
6.50	10.00	6.00	4.25	3.50	4.00	3.50	3.50	4.50	4.25	4.75	3.45	2.60	4.75	5.05
......	......	......	......	......	......	......	......	......	......	......	3.45	......	......	5.05
......	......	......	......	......	......	......	......	......	......	......	......	......	......	......

EXPORTS.

The value of roofing slate exported from this country in 1905 was $408,309; it was $449,743 in 1904, and $838,683 in 1903. These figures show a decrease of $388,940 in 1904 and a further loss of $41,434 in 1905.

According to statistics by fiscal years ending June 30, the exports of roofing slate amounted to $945,352 in 1902, to $628,612 in 1903, to $726,715 in 1904, and to $424,777 in 1905—a loss of $316,740 in 1903, a gain of $98,103 in 1904, and a loss of $301,938 in 1905.

In order to show the distribution of slate exported from this country, the following table is given by fiscal years, the figures not being furnished in this form by the Bureau of Statistics for calendar years.

The following table shows the ports and customs districts from which and to which slate has been exported since 1902:

Exports of slate from the United States, showing ports and customs districts and country from which and to which sent, in the fiscal years 1902–1905.

	1902.	1903.	1904.	1905.
Port and customs district.				
Baltimore, Md	$240,734	$221,933	$275,393	$157,649
Bangor, Me	449	1,170	30	300
Belfast, Me	375			
Boston and Charlestown, Mass	48,299	30,273	29,175	40,734
Newport News, Va	6,650	350		
New York, N. Y	374,264	207,250	284,750	145,848
Passamaquoddy, Me	160			
Philadelphia, Pa	243,701	120,240	97,247	34,245
Portland and Falmouth, Me			378	
Brazos de Santiago, Tex				
Corpus Christi, Tex	44		505	271
New Orleans, La				
Paso del Norte, Tex	20		580	
Puget Sound, Wash	1,343	1,504	1,445	1,646
San Diego, Cal				
San Francisco, Cal		1,222		
Arizona	790			
Buffalo Creek, N. Y	18,014	35,185	29,034	32,993
Champlain, N. Y	6,561	5,771	4,185	3,645
Detroit, Mich			669	1,482
Huron, Mich				
Memphremagog, Vt	246			
North and South Dakota				3,515
Oswegatchie, N. Y	3,702	3,714	3,007	1,669
Vermont			317	780
Total	945,352	628,612	726,715	424,777
Country.				
Belgium		89		
France			379	1,550
Germany	1,555		1,440	1,565
Netherlands	1,400		8,298	8,831
United Kingdom	731,556	477,251	515,085	278,111
Denmark	47,957	17,376	32,512	14,335
Norway and Sweden	25			
Bermuda	443	765	378	

Exports of slate from the United States, showing ports and customs districts and country from which and to which sent, in the fiscal years 1902–1905—Continued.

	1902.	1903.	1904.	1905.
Country—Continued.				
Dominion of Canada:				
Nova Scotia, New Brunswick, etc	$532	$1,183	$240	$160
Quebec, Ontario, etc	28,600	44,670	37,242	43,888
British Columbia	1,343	1,504	1,445	1,982
Newfoundland and Labrador			59	531
Central American States:				
Costa Rica	1,268	423		
Guatemala				
Honduras				
Nicaragua			115	
Mexico	854	479	1,085	271
Miquelon, Langley, etc				
West Indies:				
British	6,609	4,724	4,212	5,353
Haiti		52	132	
Santo Domingo				
Cuba				1,200
Brazil			761	
Colombia				692
Ecuador			251	
Guianas:				
British				
Dutch	365	1,399		
Peru				
Uruguay	195			
China			49	
East Indies—British	50			
British Australasia	121,921	75,976	120,832	66,282
British Oceania		1,222		
Hawaiian Islands				
British Africa, South	679	1,499	2,200	
Portuguese Africa				
Philippine Islands				27
Total	945,352	628,612	726,715	424,777

IMPORTS.

There is practically no slate imported into this country. In 1904 slate valued at $9,845 and in the form of chimney pieces, mantels, etc., was imported; and in 1905 the total value of imported slate was $9,854, of which $913 was for roofing slate and $8,941 for slate for other uses.

SLATE INDUSTRY BY STATES.

Arizona.—On the slate property mentioned in the report for 1904 as discovered in Arizona stripping and development work has been carried on, but as yet no slate has been marketed from this deposit.

Arkansas.—Development work has been continued in the Arkansas slate region, and with the building of roads and railroads sufficiently near the quarries to render good transportation available this material will be put upon the market, as a good demand for it is reported. It is stated that the railroad from Mena to Hot Springs is nearing completion, being already graded through the slate quarries.

California.—There was a good demand for California slate, but on account of extensive development work in the principal quarry, the output was not equal to the demand.

Georgia.—The Georgia slate quarries were not operated to any extent, but good demand and trade were reported.

Maine.—The Maine slate trade in 1905 was better than in 1904, as is evidenced by the increase in value of the output. The increase, however, was in the milled slate, both the number of squares and the value of roofing slate decreasing. The total value in 1905 was $224,254; in 1904, $181,168, an increase of $43,086.

In addition to the well-known slate quarries there is also a slate deposit in west-central Maine, in the Forks plantation, Somerset County, on the east side of the Kennebec River, said to have been operated in 1890. This deposit, which is about 18 miles west of the North Blanchard quarries, lies within the broad belt of Paleozoic slate which Prof. C. H. Hitchcock's geological map of 1885 shows as extending eastward from the Kennebec River to Schoodic Lake and beyond and as including the slate quarries of Brownville, Monson, and North Blanchard. The new slate prospect is in the southwest corner of the plantation, about 3 miles northeast of Caratunk village, a mile northeast of Pleasant Pond, and half a mile from the Washington schoolhouse. The deposit is exposed in Holly Brook, on land owned by Mr. Lawrence Hill. The approximate elevation of the prospect is 1,090 feet above sea level; that is, about 600 feet above the Kennebec River, but at about the same level as the nearest point on the Somerset Railway extension at Mosquito Narrows, 6 miles distant.

In September, 1905, this locality was visited by Prof. T. Nelson Dale in company with Dr. George Otis Smith, of the United States Geological Survey, and Prof. Leslie A. Lee, State geologist of Maine, and the following description is taken from an article by Professor Dale in Bulletin No. 285 of the United States Geological Survey:

The slate crops out in the bed of the brook, being exposed for a thickness of 30 feet or more across the cleavage. The excavation appears to have been from 10 to 15 feet deep. The cleavage strikes N. 55° E. and dips from steep northwest to 90°, but in the upper 10 feet there is a fold resulting in a steep southeast dip. The course of the bedding could not be determined, but the microscopic examination affords indications that it is nearly parallel to the cleavage.

The slate is bluish-black, of fine texture and cleavage surface, with a luster not so great as that of the Brownville slate but yet bright. It is graphitic, contains a very small amount of magnetite, has no argillaceous odor, does not effervesce in cold dilute hydrochloric acid, is quite sonorous, and is readily perforated. Neither the ledge nor the fragments exposed for fifteen years show discoloration.

Under the microscope the section shows a matrix of muscovite (sericite) with a brilliant aggregate polarization, proving it to be a mica slate. The cleavage is fine and regular. The next conspicuous feature is the presence of about 52 lenses of pyrite to each square millimeter, measuring (in transverse section) from 0.02 to 0.06 mm. in length by 0.004 to 0.016 mm. in width. In sections parallel to the cleavage these lenses have an irregular outline and are often as broad as long. They account for the limonitic staining on cleavage surfaces of water-soaked specimens. Quartz is abundant but minute. No carbonate could be detected. A few tourmaline prisms up to 0.11 mm. in length occur. Some scales of chlorite with interleaved muscovite measure up to 0.09 mm. Occasional zircon fragments and aggregations of rutile crystals appear.

The constituents of this slate, arranged in the order of their abundance, appear to be muscovite, quartz, chlorite, pyrite, and graphite, with accessory tourmaline, zircon, and rutile.

This slate at Pleasant Pond (the nearest important topographic feature) represents a different quality of black slate from either the Brownville or the Monson slate, having nearly as much luster and nearly as fine cleavage as the Brownville, yet without its abundance of magnetite and being without the dull and roughish surface of the Monson slate. It would prove suitable either for roofing or mill-stock purposes.

Another ledge of similar slate has been exposed by trenching, about a third of a mile away, near the road and Mr. Hill's house; but the slate here shows some false cleavage, at least at the surface. Should that feature continue into the mass, the slate would have little or no commercial value. This feature was not characteristic of the Holly Brook outcrop.[a]

[a] Contributions to Economic Geology, 1905: Bull. U. S. Geol. Survey No. 285, 1906.

Maryland.—Although conditions in Maryland were not reported as very favorable in 1905 the output increased in comparison with 1904, being valued at $133,972 in 1904 and at $151,215 in 1905, an increase of $17,243.

New York.—There was a slight decrease in the New York slate output in 1905, due to less mill stock being produced. The roofing slate showed an increase. The total value was $71,543 in 1904 and $66,646 in 1905, a decrease of $4,897.

Pennsylvania.—The slate quarrymen of Pennsylvania seemed to suffer more from adverse conditions in 1905 than those of the other States. Demand was spasmodic, in some cases greater, in others less; in general about the same as in 1904, but 1904 was not considered a good year. The demand was principally for the cheaper grades of roofing slate, the production being larger, but the prices less by from 10 to 20 per cent. The demand for mill stock was not so good as in 1904.

There was less export trade, and in many instances the quarry conditions were not such that the best slate could be taken out, operators taking advantage of slow demand to enlarge or improve their quarries.

The total output was valued at $3,633,246 in 1904 and at $3,491,905 in 1905, a decrease of $141,341.

The number of squares produced increased from 778,825 in 1904 to 802,170 in 1905, or 23,345 squares. The value of these squares decreased from $2,922,259 in 1904 to $2,879,671 in 1905, a decrease of $42,588. The average value per square was $3.75 in 1904 and $3.59 in 1905, a decrease of 16 cents per square.

Of the three counties producing slate in Pennsylvania—York, Lehigh, and Northhampton—York County showed an increase in output; Lehigh decreased in total value and in the value of mill stock, but increased in quantity and value of roofing slate; and Northampton, whose output more than equals that of Lehigh and York combined, decreased in value of mill stock and in number of squares produced, and also decreased in the value of these squares.

The following table shows the slate production in Pennsylvania in 1904 and 1905, by counties:

Slate production in Pennsylvania in 1904 and 1905, by counties.

1904.

County.	Number of squares.	Value.	Milled slate.	Total. value.
York	14,239	$79,992	....	$79,992
Lehigh	205,563	808,428	$206,734	1,015,162
Northampton	559,023	2,033,839	504,253	2,538,092
Total	778,825	2,922,259	710,987	3,633,246

1905.

County.	Number of squares.	Value.	Milled slate.	Total. value.
York	16,636	$93,957	$250	$94,207
Lehigh	231,194	826,808	120,130	946,938
Northampton	554,340	1,958,906	491,854	2,450,760
Total	802,170	2,879,671	612,234	3,491,905

Tennessee.—Development work only was done in the Tennessee quarries in 1905. Transportation facilities are being provided which will render this product capable of being put on the market.

Utah.—Development work, with no output for commercial purposes, was done in the Utah slate quarries in 1905.

Vermont.—There was a decrease in the number of squares and in the value of roofing slate quarried in Vermont in 1905, and a small increase in value of milled slate, resulting, however, in a decrease of $55,610 in the total value, from $1,408,151 in 1904 to $1,352,541 in 1905. The average price per square increased 1 cent, from $3.45 in 1904 to $3.46 in 1905. The roofing-slate operators reported generally lower prices and slow demand, while those dealing in milling stock noted conditions as very favorable.

Virginia.—There was considerable activity in the slate trade in Virginia in 1905, new quarries being opened and old ones reopened. There was a good demand for this slate, although prices were reported lower and labor higher and scarce. The output increased from 31,852 squares, valued at $130,208, in 1904, to 36,102 squares, valued at $146,786, in 1905, an increase of 4,250 squares and of $16,578 in value.

STONE.[a]

INTRODUCTION.

The figures of production as given in this report are classified for simplicity of treatment into the following classes: granite, trap rock, sandstone, bluestone, limestone, and marble.

Under granite is included the true granites and other igneous rocks as gneiss, mica schist, andesite, syenite, a small quantity of serpentine, quartz porphyry, lava, and tufa stone, diabase, trap rock, basalt, diorite, and gabbro. These in themselves are quarried in too small quantities to admit of the practicability of being tabulated separately. The trap rock output of California, Connecticut, Massachusetts, New York, New Jersey, and Pennsylvania, however, represents an industry by itself, and it is, therefore, considered advisable to show the value of this stone separately from the other granite.

Under sandstone, in the States of New York, New Jersey, Pennsylvania, and West Virginia, is included a variety of sandstone called bluestone, and as this is an industry by itself in New York and Pennsylvania a table is given showing the output apart from the sandstone. In Kentucky a variety of sandstone is quarried locally known as freestone.

The figures given for sandstone do not include the value of sandstone quarried and made into abrasive materials, the sandstone crushed into sand and used in the manufacture of glass, etc., nor bituminous sandstone.

The limestone figures in previous reports have included the lime burned from a large quantity of limestone quarried whose value could only be reported as lime. In 1905, however, the lime industry, being closely allied with other lime products, is given in a separate report, and the value of the lime is excluded from all totals appearing in this report. In limestone also is included some stone sold locally as marble, but not reported separately by quarrymen.

Marble includes a small quantity of serpentine marble quarried in Georgia, Washington, and Pennsylvania, and a small quantity of onyx marble.

Slate, which has formerly appeared as a chapter of the stone report, is published separately for 1905, the figures for slate being excluded from the totals given below.

The values given represent the value of the stone as it leaves the hands of the quarrymen and does not include any freight charges. When the stone is worked or dressed by the quarry owners and sold in this manner, the value of the dressed stone is given. This applies especially to the stone quarried for use as building stone and for monumental stone.

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[a] The collection and compilation of the statistics and the preparation of this report have been carried on by Miss A. T. Coons, statistical expert, of this office.—D. T. D.

PRODUCTION.

The following table shows the value of different kinds of stone produced in the United States from 1895 to 1905, inclusive:

Value of the different kinds of stone produced in the United States, 1895–1905.

Year.	Granite.	Trap rock.	Sandstone.	Bluestone.	Marble.	Limestone.	Total.
1895	$8,894,328	....	$4,211,314	a $750,000	$2,825,719	$9,974,222	$26,655,583
1896	7,944,994	....	4,023,199	a 750,000	2,859,136	8,387,900	23,965,229
1897	8,905,075	....	4,065,445	a 900,000	3,870,584	9,135,567	26,876,671
1898	9,324,406	....	4,724,412	a 1,000,000	3,629,940	9,956,417	28,635,175
1899	10,343,298	$1,275,041	b 4,910,111	815,284	4,011,681	13,889,302	35,244,717
1900	10,969,417	1,706,200	b 5,272,865	1,198,519	4,267,253	13,556,523	36,970,777
1901	14,266,104	1,710,857	b 6,974,199	1,164,481	4,965,699	18,202,843	47,284,183
1902	16,083,475	2,181,157	b 9,430,958	1,163,525	5,044,182	20,895,385	54,798,682
1903	15,703,793	2,732,294	b 9,482,802	1,779,457	5,362,686	22,372,109	57,433,141
1904	17,191,479	2,823,546	b 8,482,162	1,791,729	6,297,835	22,178,964	58,765,715
1905	17,563,139	3,074,554	b 8,075,149	1,931,625	7,129,071	26,025,210	63,798,748

a Estimated. b Does not include value of grindstones and whetstones.

From this table it will be seen that the total value, excluding the products above mentioned, of the stone reported to this office in 1905 was $63,798,748. The corresponding value for 1904 was $58,765,715, an increase of $5,033,033. In 1904, when the figures for 1903 were $57,433,141, the gain was $1,332,574; in 1903 the gain over the figures for 1902 ($54,798,682) was $2,634,459; in 1902 the gain was $7,514,499, and in 1901 $10,313,406. The increased output for 1905 was caused by more activity in the building trades, and chiefly by a large increase in the output of limestone for use as furnace flux, as demanded by the reopening of many iron furnaces.

Granite, marble, and limestone increased in value of output, while sandstone decreased slightly.

Limestone showed the largest increase—from $22,178,964 in 1904 to $26,025,210 in 1905, or $3,846,246.

Granite, including trap rock, gneiss, basalt, etc., increased from $20,015,025 in 1904 to $20,637,693 in 1905, a gain of $622,668. The trap rock increased from $2,823,546 in 1904 to $3,074,554 in 1905, or $251,008. Other granite increased from $17,191,479 in 1904 to $17,563,139 in 1905, a gain of $371,660.

Marble increased from $6,297,835 in 1904 to $7,129,071 in 1905, a gain of $831,236.

Sandstone, including bluestone, decreased from $10,273,891 in 1904 to $10,006,774 in 1905, a loss of $267,117. Bluestone increased from $1,791,729 in 1904 to $1,931,625 in 1905, a gain of $139,896. The sandstone figures decreased $407,013—from $8,482,162 in 1904 to $8,075,149 in 1905.

The following tables show the value of different kinds of stone produced in the United States in 1904 and 1905, by States:

Value of various kinds of stone produced in 1904 and 1905, by States.

1904.

State.	Granite.	Sandstone.	Marble.	Limestone.	Total value.
Alabama		$12,788	(a)	$198,723	$511,511
Alaska			(a)		
Arizona	$2,500	91,960	(a)	250	94,710
Arkansas	52,616	63,950	(a)	106,147	222,713
California	[b] 1,742,330	735,662	$87,659	74,670	2,640,321
Colorado	91,132	281,142		124,600	496,874
Connecticut	[b] 854,784	117,696	(a)	830	973,310
Delaware	245,272				245,272
Florida				34,278	34,278
Georgia	942,466		690,714	15,200	1,648,380
Hawaii	22,042				22,042
Idaho		9,320		5,900	15,220
Illinois		47,377		2,690,822	2,738,199
Indiana		22,681		2,789,500	2,812,181
Indian Territory	5,152			6,076	11,228
Iowa		9,300		442,585	451,885
Kansas		130,516		799,286	929,802
Kentucky		93,622		692,417	786,039
Louisiana		8,315			8,315
Maine	2,400,509			2,955	2,403,464
Maryland	815,471	8,998	73,814	128,421	1,026,704
Massachusetts	[b] 2,868,305	320,861	183,388	7,566	3,380,120
Michigan		74,868		501,708	576,576
Minnesota	405,956	319,209		517,940	1,243,105
Mississippi	440				440
Missouri	155,716	44,455	(a)	2,277,969	2,478,140
Montana	33,890	64,232		109,765	207,887
Nebraska		142		236,780	236,922
Nevada	1,200	10,558			11,758
New Hampshire	927,487				927,487
New Jersey	[b] 833,518	236,426		76,710	1,146,654
New Mexico		133,390	4,250		137,640
New York	622,986	[c] 1,755,524	565,987	1,636,255	4,580,752
North Carolina	297,749	250	2,741	12,088	312,828
Ohio		1,808,062		2,406,355	4,214,417
Oklahoma	26,930	2,995		92,246	122,171
Oregon	235,213	6,186		5,390	246,789
Pennsylvania	[b] 900,530	[c] 2,641,510	90,390	3,708,750	7,341,180
Rhode Island	684,952			312	685,264
South Carolina	382,428			225	382,653
South Dakota	900	338,970		3,954	343,824
Tennessee		24,868	505,259	288,053	818,180
Texas	348,317	209,313		252,745	810,375
Utah	7,980	70,168	3,950	170,447	252,545
Vermont	2,447,979		4,004,669	9,653	6,462,301
Virginia	510,788	13,522		165,459	689,769
Washington	422,508	88,185	23,098	71,857	605,648
West Virginia		287,381		460,303	747,684
Wisconsin	724,422	158,503		738,684	1,621,609
Wyoming	557	30,986	2,000	15,090	48,633
Other States			[d] 59,916		59,916
Total	[b] 20,015,025	[c] 10,273,891	[d] 6,297,835	22,178,964	58,765,715

[a] Included in other States.
[b] Includes trap rock.
[c] Includes bluestone.
[d] Includes Alabama, Alaska, Arizona, Arkansas, Connecticut, and Missouri.

Value of various kinds of stone produced in 1904 and 1905, by States—Continued.

1905.

State.	Granite.	Sandstone.	Marble.	Limestone.	Total value.
Alabama		$28,107		$532,103	$560,210
Alaska			$710		710
Arizona	$3,700	65,558		135	69,393
Arkansas	90,312	58,161	1,000	154,818	304,291
California	1,700,818	685,668	95,540	49,902	2,531,928
Colorado	73,802	453,029		289,920	816,751
Connecticut	949,888	62,618		1,558	1,014,064
Delaware	178,428				178,428
Florida				5,800	5,800
Georgia	971,207		774,550	9,030	1,754,787
Hawaii	33,550				33,550
Idaho	1,500	22,265		14,105	37,870
Illinois		29,115		3,511,890	3,541,005
Indiana		15,421		3,189,259	3,204,680
Indian Territory	1,800	2,198		5,512	9,510
Iowa		9,335		451,791	461,126
Kansas		79,617		923,389	1,003,006
Kentucky		280,579		744,465	1,025,044
Louisiana					
Maine	2,713,795			7,428	2,721,223
Maryland	957,048	12,984	138,404	149,402	1,257,838
Massachusetts	2,663,329	367,461	166,360	65,908	3,263,058
Michigan		123,123		544,754	667,877
Minnesota	481,908	294,640		555,401	1,331,949
Mississippi					
Missouri	180,579	27,686		2,238,164	2,446,429
Montana	126,430	45,116		103,123	274,669
Nebraska		120		225,119	225,239
Nevada		1,500			1,500
New Hampshire	838,371				838,371
New Jersey	834,709	294,719		147,353	1,276,781
New Mexico		101,522	2,200	7,200	110,922
New York	765,777	[a] 1,831,756	795,721	1,970,968	5,364,222
North Carolina	564,578	4,483		16,500	585,561
North Dakota		1,055			1,055
Ohio		1,744,472		2,850,793	4,595,265
Oklahoma	18,920	12,914		163,412	195,246
Oregon	85,330	1,229		8,600	95,159
Pennsylvania	870,848	[a] 2,487,939	97,887	4,499,503	7,956,177
Rhode Island	556,364			300	556,664
South Carolina	297,284				297,284
South Dakota		193,408		6,653	200,061
Tennessee		8,715	582,229	401,622	992,566
Texas	132,193	123,281		171,847	427,321
Utah	13,630	43,429	1,150	232 519	290,728
Vermont	2,571,850		4,410,820	11,095	6,993,765
Virginia	452,390	2,000		212,660	667,050
Washington	681,730	124,910	60,000	52,470	919,110
West Virginia		171,309		671,318	842,627
Wisconsin	825,625	161,741		804,081	1,791,447
Wyoming		33,591	2,500	23,340	59,431
Total	[b] 20,637,693	[a] 10,006,774	7,129,071	26,025,210	63,798,748

[a] Includes bluestone.

[b] Includes trap and other igneous rocks.

The following table shows the rank of the States in 1904 and 1905, according to value of production, and the percentage of the total produced by each State:

Rank of States in 1904 and 1905, according to value of production, and percentage of total produced by each State.

1904.				1905.			
Rank of State.	State.	Total value.	Percentage of total.	Rank of State.	State.	Total value.	Percentage of total.
1	Pennsylvania	$7,341,180	12.49	1	Pennsylvania	$7,956,177	12.47
2	Vermont	6,462,301	11.00	2	Vermont	6,993,765	10.96
3	New York	4,580,752	7.79	3	New York	5,364,222	8.41
4	Ohio	4,214,417	7.17	4	Ohio	4,595,265	7.20
5	Massachusetts	3,380,120	5.75	5	Illinois	3,541,005	5.55
6	Indiana	2,812,181	4.79	6	Massachusetts	3,263,058	5.11
7	Illinois	2,738,199	4.66	7	Indiana	3,204,680	5.02
8	California	2,640,321	4.49	8	Maine	2,721,223	4.27
9	Missouri	2,478,140	4.22	9	California	2,531,928	3.97
10	Maine	2,403,464	4.09	10	Missouri	2,446,429	3.83
11	Georgia	1,648,380	2.81	11	Wisconsin	1,791,447	2.81
12	Wisconsin	1,621,609	2.76	12	Georgia	1,754,787	2.75
13	Minnesota	1,243,105	2.12	13	Minnesota	1,331,949	2.09
14	New Jersey	1,146,651	1.95	14	New Jersey	1,276,781	2.00
15	Maryland	1,026,704	1.75	15	Maryland	1,257,838	1.97
16	Connecticut	973,310	1.66	16	Kentucky	1,025,044	1.61
17	Kansas	929,802	1.58	17	Connecticut	1,014,064	1.59
18	New Hampshire	927,487	1.58	18	Kansas	1,003,006	1.57
19	Tennessee	818,180	1.39	19	Tennessee	992,566	1.56
20	Texas	810,375	1.38	20	Washington	919,110	1.44
21	Kentucky	786,039	1.31	21	West Virginia	842,627	1.32
22	West Virginia	747,684	1.27	22	New Hampshire	838,371	1.31
23	Virginia	689,769	1.17	23	Colorado	816,751	1.28
24	Rhode Island	685,264	1.17	24	Michigan	667,877	1.05
25	Washington	605,648	1.03	25	Virginia	667,050	1.05
26	Michigan	576,576	.98	26	North Carolina	585,561	.92
27	Alabama	511,511	.87	27	Alabama	560,210	.88
28	Colorado	496,874	.85	28	Rhode Island	556,664	.87
29	Iowa	451,885	.77	29	Iowa	461,126	.72
30	South Carolina	382,653	.65	30	Texas	427,321	.67
31	South Dakota	343,824	.58	31	Arkansas	304,291	.48
32	North Carolina	312,828	.53	32	South Carolina	297,284	.47
33	Utah	252,545	.43	33	Utah	290,728	.46
34	Oregon	246,789	.42	34	Montana	274,669	.43
35	Delaware	245,272	.42	35	Nebraska	225,239	.35
36	Nebraska	236,922	.40	36	South Dakota	200,061	.31
37	Arkansas	222,713	.38	37	Oklahoma	195,246	.31
38	Montana	207,887	.35	38	Delaware	178,428	.28
39	New Mexico	137,640	.23	39	New Mexico	110,922	.17
40	Oklahoma	122,171	.21	40	Oregon	95,159	.15
41	Arizona	94,710	.16	41	Arizona	69,393	.11
42	Other States	a59,916	.10	42	Wyoming	59,431	
43	Wyoming	48,633		43	Idaho	37,870	
44	Florida	34,278		44	Hawaii	33,550	
45	Hawaii	22,042		45	Indian Territory	9,510	
46	Idaho	15,220		46	Florida	5,800	.23
47	Nevada	11,758	.26	47	Nevada	1,500	
48	Indian Territory	11,228		48	North Dakota	1,055	
49	Louisiana	8,315		49	Alaska	710	
50	Mississippi	440					
	Total	58,765,715	100.00		Total	63,798,748	100.00

a Includes small values for marble quarried in Alabama, Alaska, Arizona, Arkansas, Connecticut, and Missouri.

From this table it will be seen that in 1905 Pennsylvania, producing all varieties of stone, ranked first in value of output. Vermont was second, followed by New York, Ohio, Illinois, Massachusetts, Indiana, Maine, California, and Missouri, in the order named, each State having a value of over $2,000,000 for the total output. In 1904 this order was: Pennsylvania, Vermont, New York, Ohio, Massachusetts, Indiana, Illinois, California, Missouri, and Maine.

The following table is given to show the total values of the stone used for various purposes in 1904 and 1905; 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 1904 and 1905.

1904.

Kind.	Building (rough and dressed).	Monumental (rough and dressed).	Flagstone.	Curbstone.	Paving.	Crushed stone.
Granite	$6,910,425	$3,663,682	$58,152	$769,462	$1,983,328	$4,952,045
Sandstone	5,125,858		1,110,163	1,253,492	664,062	1,019,451
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

1905.

Kind.	Building (rough and dressed).	Monumental (rough and dressed).	Flagstone.	Curbstone.	Paving.	Crushed stone.
Granite	$7,298,797	$3,842,368	$38,838	$762,430	$2,133,873	$4,923,706
Sandstone	4,702,189		1,221,348	1,044,983	716,682	1,008,270
Limestone	5,312,183		127,801	283,426	231,785	10,487,638
Marble	2,927,640	2,270,217				
Total	20,240,809	6,112,585	1,387,987	2,090,839	3,082,340	16,419,614

As will be seen from this table, the value of building stone increased $1,357,354, from $18,883,455 in 1904 to $20,240,809 in 1905. In 1904 the building stone output decreased $912,036 from $19,795,491 in 1903.

In 1905 monumental stone increased $120,871, from $5,991,714 in 1904 to $6,112,585 in 1905.

The value of flagstone increased from $1,276,344 in 1904 to $1,387,987 in 1905, a gain of $111,643.

The value of curbstone decreased $209,887, from $2,300,726 in 1904 to $2,090,839 in 1905.

Paving material was valued at $2,834,060 in 1904 and at $3,082,340 in 1905, an increase of $248,280.

Crushed stone increased from $15,530,122 in 1904 to $16,419,614 in 1905, a gain of $889,492. In 1905 for the first time the statistics of the quantity of stone crushed were collected.

The following tables show the values of crushed stone produced in the United States, by varieties of stone, in 1904 and 1905, and in 1905 also the quantity of stone:

Value of crushed stone produced in the United States in 1904, by kinds of stone.

Kind.	Road making.	Railroad ballast.	Concrete.	Total value.
Granite	$857,627	$514,328	$957,337	$2,329,292
Trap rock	1,652,072	400,284	570,397	2,622,753
Limestone	3,714,987	3,153,002	2,690,637	9,558,626
Sandstone	338,287	440,442	240,722	1,019,451
Total	6,562,973	4,508,056	4,459,093	15,530,122

Quantity and value of crushed stone produced in the United States in 1905, by kinds of stone.

[Short tons.]

Kind.	Road making.		Railroad ballast.		Concrete.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Granite	884,934	$756,923	733,397	$428,567	1,037,995	$960,110	2,656,326	$2,145,600
Trap rock	2,634,290	1,762,811	435,511	230,376	1,207,240	784,919	4,277,041	2,778,106
Limestone	6,446,518	3,837,041	8,167,261	3,826,811	4,720,389	2,823,786	19,334,168	10,487,638
Sandstone	452,268	355,269	769,404	341,957	371,415	311,044	1,593,087	1,008,270
Total	10,418,010	6,712,044	10,105,573	4,827,711	7,337,039	4,879,859	27,860,622	16,419,614

These figures show an increase in the limestone and trap rock crushed and a decrease in granite and sandstone.

The total average value per short ton in 1905 was 59 cents. The average value per ton of granite was 81 cents; trap rock, 65 cents; limestone, 54 cents; and sandstone, 63 cents.

The following tables show the value of crushed stone produced in the United States, by States, in 1904 and 1905, and in 1905 the quantity of crushed stone:

Value of crushed stone produced in the United States in 1904, by States.

State.	Granite.	Limestone.	Sandstone.	Total value.
Alabama		$17,356		$17,356
Arizona			$1,580	1,580
Arkansas	$34,566	39,050	11,425	85,041
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	4,952,045	9,558,626	1,019,451	15,530,122

Quantity and value of crushed stone produced in 1905, by States.

[Short tons.]

State.	Road making.		Railroad ballast.		Concrete.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama	15,000	$3,725			15,700	$7,275	30,700	$11,000
Arizona					500	229	500	229
Arkansas	47,350	34,325	16,524	$12,012	87,310	72,220	151,184	118,557
California	624,698	391,587	87,733	48,341	386,967	305,459	1,099,398	745,387
Colorado					8,200	4,033	8,200	4,033
Connecticut	293,240	176,749	17,806	8,067	210,027	116,387	521,073	301,203
Delaware	61,125	36,440	74,052	39,779	45,130	27,164	180,307	103,383
Florida					600	300	600	300
Georgia	17,140	7,300	160,365	82,717	86,225	63,763	263,730	153,780
Hawaii			4,700	3,542	28,202	28,508	32,902	32,050
Illinois	1,184,352	793,551	1,441,707	655,276	929,995	594,293	3,556,054	2,043,120
Indiana	489,724	222,441	280,227	84,007	77,130	30,364	847,081	336,812
Indian Territory			9,058	3,624	3,634	1,888	12,692	5,512
Iowa	56,253	65,843	26,610	14,262	80,490	82,024	163,353	162,129
Kansas	46,210	28,913	1,389,756	618,189	38,666	25,365	1,474,632	672,467
Kentucky	334,198	215,032	980,597	362,035	79,392	65,427	1,394,187	642,494
Maine	4,935	2,605	212	96	10,070	7,615	15,217	10,316
Maryland	191,814	165,422	89,588	44,336	222,004	245,200	503,406	454,958
Massachusetts	616,170	497,207	16,788	9,436	390,314	288,227	1,023,272	794,870
Michigan	237,670	112,113	87,298	43,649	229,355	107,396	554,323	263,158
Minnesota	99,083	79,640	16,820	16,958	245,231	134,410	361,134	231,008
Missouri	453,254	386,894	902,433	396,872	779,753	519,469	2,135,440	1,303,235
Montana					6,500	8,200	6,500	8,200
Nebraska	31,375	24,050	51,875	29,442	92,000	79,311	175,250	132,803
New Hampshire	26,681	16,467					26,681	16,467
New Jersey	711,538	497,779	156,497	98,342	247,190	167,258	1,115,225	763,379
New Mexico			185,000	85,000	1,625	1,575	186,625	86,575
New York	1,463,311	909,425	844,382	418,076	758,096	451,811	3,065,789	1,779,312
North Carolina	52,987	44,236	118,850	56,574	55,549	34,161	227,386	134,971
Ohio	1,622,756	805,345	858,047	463,435	548,714	259,363	3,029,517	1,528,143
Oklahoma	37,700	22,850	187,500	90,000	31,870	21,370	257,070	134,220
Oregon	46,877	34,720	1,250	600	1,688	1,550	49,815	36,870
Pennsylvania	784,176	490,025	1,584,547	836,001	967,134	589,952	3,335,857	1,915,978
Rhode Island	33,821	27,061	2,875	2,000	16,125	15,470	52,821	44,531
South Carolina	1,250	900	42,804	28,876	70,866	70,392	114,920	100,168
South Dakota	1,000	804			21,000	18,205	22,000	19,009
Tennessee	106,850	39,227	167,850	81,693	92,400	48,930	367,100	169,850
Texas	11,250	7,000	32,700	16,000	48,300	34,518	92,250	57,518
Utah	6,907	6,605			350	150	7,257	6,755
Vermont	5,300	4,073			4,500	6,000	9,800	10,073
Virginia	15,500	26,429	142,600	78,693	154,862	177,551	312,962	282,673
Washington	12,040	9,000	2,047	1,638	753	602	14,840	11,240
West Virginia	69,048	38,084	97,000	85,823	67,790	36,938	233,838	160,845
Wisconsin	605,427	488,177	14,975	7,870	194,767	129,501	815,169	625,548
Wyoming			12,500	4,450	65	35	12,565	4,485
Total	10,418,010	6,712,044	10,105,573	4,827,711	7,337,039	4,879,859	27,860,622	16,419,614

In 1905 Illinois quarried the greatest quantity of crushed stone, being followed by Pennsylvania, New York, Ohio, and Missouri, in the order named. Each of these States produced over one million dollars' worth of crushed stone. In 1904 the order was Pennsylvania, Illinois, New York, Missouri, and Ohio.

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 1904 and 1905:

Exports of stone from the United States in 1904 and 1905.

Kind.	1904.	1905.
Marble and stone, unmanufactured	$203,086	$265,023
All others	684,925	710,876
Total	888,011	975,899

Imports of stone into the United States in 1904 and 1905.

Kind.	1904.	1905.
Marble:		
In block, rough, etc	$851,841	$817,555
Sawed or dressed	265	103
Slabs or paving tiles	55,287	63,942
All other manufactures	243,931	302,645
Mosaic cubes	35,128	47,455
Total	1,186,452	1,231,700
Onyx:		
In block, rough, etc	63,975	54,081
Sawed or dressed	....	....
Slabs or tiles	....	176
All other manufactures	11,485	6,261
Total	75,460	60,518
Granite:		
Dressed	111,543	102,488
Rough	6,573	4,940
Total	118,116	107,428
Stone (other):		
Dressed	24,680	14,711
Rough	15,974	64,587
Total	40,654	79,298
Grand total	1,420,682	1,478,944

These tables do not include the figures for slate or lime, as they are included under their respective reports.

GRANITE AND OTHER IGNEOUS ROCKS.

The stone classed as granite in this report includes gneiss, mica schist, lava, tufa, andesite, syenite, quartz porphyry, trap, basalt, and allied igneous rocks, with a small production of serpentine. Too small quantities of these allied stones are quarried to make it practicable to tabulate them separately. Trap, however, as quarried in California, Connecticut, Massachusetts, 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 includes considerable basalt quarried and manufactured mostly into paving blocks.

This class of stone, as well as limestone and sandstone, has felt to some extent the effect of the demand for concrete block and cement work, but this demand and the almost universal reports by quarrymen of high prices paid for labor have not prevented a considerable increase in the total value of the output, although the increase for 1905 over 1904 was not so great as that for 1904 over 1903.

The total value for 1905 was $20,637,693; for 1904 $20,015,025, a gain of $622,668; the figures for 1903 were $18,436,087, showing a gain for 1904 over 1903 of $1,578,938.

Building stone, including rough and dressed stone, was valued at $7,298,797 in 1905 and at $6,940,425 in 1904, an increase of $358,372.

Monumental stone, including rough and dressed stone, was valued at $3,842,368 in 1905 and at $3,663,682 in 1904, an increase of $178,686.

Under stone sold, "rough for other purposes," is included a large quantity of stone used for breakwater and jetty work. This increased from $648,394 in 1904 to $848,481 in 1905, or $200,087.

The value of flagstone, curbstone, and rubble decreased in 1905, while riprap increased in value.

Crushed stone decreased from $4,952,045 in 1904 to $4,923,706 in 1905, a loss of $28,339. The quantity of granite, including trap rock, basalt, etc., quarried and crushed in 1905, amounted to 6,933,367 short tons, an average value of 71 cents per short ton. The trap rock from the States of California, Connecticut, Massachusetts, New Jersey, New York, and Pennsylvania make up a little over one-half of the value and nearly two-thirds of the tonnage, the figures being 2,656,326 short tons of granite, valued at $2,145,600, and 4,277,041 short tons of trap rock, valued at $2,778,106. This gives an average value per ton of 81 cents for the granite and of 65 cents for the trap rock.

The principal States in order of value of output in 1905 are Maine, Massachusetts, Vermont, California, Georgia, Connecticut, and Maryland, with values each of over $900,000. In 1904, Massachusetts, Vermont, Maine, California, Georgia, New Hampshire, and Pennsylvania were the States giving an output each of over $900,000.

The following tables show the value of the granite, trap, etc., produced in the United States in 1904 and 1905, by States and uses:

Value of granite, trap, etc., produced in United States in 1904 and 1905, by States and uses.

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
Hawaii								
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, trap, etc., produced in United States in 1904 and 1905, by States and uses—Continued.

1904.

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	1,742,380
Colorado	20,228						91,132
Connecticut	177,842	45,183	76,272	7,812	21,886	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
Hawaii	3,133	10,000	8,909				22,042
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	2,509,699	914,612	1,527,734	764,920	175,702	58,915	20,015,025

Value of granite, trap, etc., produced in United States in 1904 and 1905, by States and uses—Continued.

1905.

State.	Sold in the rough.			Dressed for building.	Dressed for monumental work.	Made into paving blocks.	Curbing.	Flagging.
	Building.	Monumental.	Other.					
Arizona	....	....	....	$200	$3,500	....	....	....
Arkansas	$580	$300	$6,210	....	....	$457	$5,395	$5
California	37,586	63,502	155,989	304,521	117,605	250,801	86,170	450
Colorado	2,495	19,016	283	9,405	23.936	....	18,375	80
Connecticut	163,835	28,238	4,004	230,736	52,125	43,931	22,091	1,383
Delaware	6,384	53	....	14,480	....	6,836	3,281	133
Georgia	89,350	50,038	2,020	101,375	25	296,750	246,543	2,310
Hawaii	....	....	....	....	....	....	....	....
Idaho	1,500	....	....	....	....	....	....	....
Indian Territory	1,800	....	....	....	....	....	....	....
Maine	434,402	77,543	32,032	1,648,687	69,910	324,858	74,701	9,720
Maryland	233,716	38,860	6,672	125,177	4,600	38,900	21,742	7,419
Massachusetts	201,425	424,944	5,083	824,999	189,131	270,308	92,420	5,750
Minnesota	11,804	36,689	1,038	58,083	193,110	98,530	15,815	1,340
Missouri	8,424	20,301	....	9,413	10,500	69,640	2,865	....
Montana	9,100	7,030	....	66,500	27,300	3,500	6,000	....
New Hampshire	76,609	129,685	11,261	254,928	227,799	76,822	25,754	1,655
New Jersey	14,446	2,312	140	16,440	....	58,322	....	....
New York	18,124	117	....	106,852	7,013	20,600	1,520	....
North Carolina	75,125	5,969	800	228,726	3,142	48,234	70,535	3,773
Oklahoma	7,100	3,100	500	4,560	3,200	....	180	....
Oregon	10,341	3,049	8,771	5,535	9,850	80	850	....
Pennsylvania	193,462	1,810	640	71,195	....	35,026	9,034	....
Rhode Island	7,050	134,063	1,592	75,688	203,267	82,641	3,660	1,092
South Carolina	18,989	29,740	55,957	40,670	14,250	9,604	14.197	1,178
Texas	22,935	15,100	20,589	24,800	30,200	250	450	....
Utah	891	1,785	50	64	550	....	....	....
Vermont	188,391	778,681	11,200	1,093,688	471,093	16,628	7,088	....
Virginia	31,224	10,415	....	28,950	37,180	19,220	8,948	2,550
Washington	14,322	9,851	523,500	64,215	4,000	420	22,770	....
Wisconsin	6,600	28,252	150	900	218,639	361,515	2,046	....
Total	1,888,010	1,920,443	848,481	5,410,787	1,921,925	2,133,873	762,430	38,838

Value of granite, trap, etc., produced in United States in 1904 and 1905, by States and uses—Continued.

1905.

State.	Crushed stone.			Rubble.	Riprap.	Other.	Total.
	Road making.	Railroad ballast.	Concrete.				
Arizona							$3,700
Arkansas	$18,825	$10,000	$35,120	$9,820	$3,600		90,312
California	295,982	35,629	302,759	6,387	35,880	$7,557	1,700,818
Colorado			200		12		73,802
Connecticut	176,749	8,067	116,387	16,921	73,609	11,812	949,888
Delaware	36,440	39,779	27,164	993	42,885		178,428
Georgia	7,300	77,717	62,763	29,314		5,702	971,207
Hawaii		3,542	28,508			1,500	33,550
Idaho							1,500
Indian Territory							1,800
Maine	2,605	96	7,615	5,223	1,675	24,728	2,713,795
Maryland	133,599	8,046	212,592	102,733	2,996	19,996	957,048
Massachusetts	339,963	9,436	172,303	90,562	18,897	18,108	2,663,329
Minnesota	28,501	5,118	23,231	7,579	300	770	481,908
Missouri	10,470	15,854	31,182			1,930	180,579
Montana			7,000				126,430
New Hampshire	16,467			9,910	3,036	4,415	838,371
New Jersey	488,379	98,342	147,333	1,041	3,500	4,454	834,709
New York	453,051	69,600	70,250	17,000	200	1,450	765,777
North Carolina	27,736	56,574	34,161	6,311	2,842	650	564,578
Oklahoma				180		100	18,920
Oregon	30,194	600	1,550	3,340	11,170		85,330
Pennsylvania	187,643	118,669	205,363	5,747	4,664	37,595	870,848
Rhode Island	27,061	2,000	15,470	478	30	2,272	556,364
South Carolina	900	28,876	70,392	10,630	1,901		297,284
Texas			1,000		15,869	1,000	132,193
Utah	5,715			4,340	235		13,630
Vermont	3,723				40	1,318	2,571,850
Virginia	21,175	69,360	166,364	28,961	27,236	807	452,390
Washington	9,000	1,638	602	25,580	5,832		681,730
Wisconsin	198,256		5,720	366		3,181	825,625
Total	2,519,734	658,943	1,745,029	383,446	256,409	149,345	20,637,693

The following table shows the value of the production of granite, trap, etc., in the United States from 1901 to 1905, inclusive:

Value of granite, trap, etc., produced in the United States, 1901–1905.

State.	1901.	1902.	1903.	1904.	1905.
Arizona	....	$3,000	$3,000	$2,500	$3,700
Arkansas	$23,554	12,115	47,136	52,616	90,312
California	1,134,675	1,137,679	1,627,592	1,742,330	1,700,818
Colorado	138,996	66,023	100,791	91,132	73,802
Connecticut	616,654	812,141	1,101,425	854,784	949,888
Delaware	671,204	276,753	369,166	245,272	178,428
Georgia	761,646	803,778	672,947	942,466	971,207
Hawaii	....	6,688	....	22,042	33,550
Idaho	5,100	12,910	2,750	....	1,500
Indian Territory	....	....	4,030	5,152	1,800
Kansas	48,530	....	....	....	....
Maine	2,703,116	2,659,450	2,586,765	2,400,509	2,713,795
Maryland	613,356	758,203	837,787	815,471	957,048
Massachusetts	2,216,258	3,451,397	2,720,066	2,868,305	2,663,329
Michigan	2,706	....	....	....	....
Minnesota	260,105	478,989	403,906	405,956	481,908
Mississippi	....	....	....	440	....
Missouri	95,806	157,708	150,409	155,716	180,579
Montana	....	77,050	25,993	33,890	126,430
Nevada	19,300	2,090	7,450	1,200	....
New Hampshire	935,494	1,147,097	854,513	927,487	838,371
New Jersey	894,167	948,474	943,171	833,518	834,709
New York	489,828	651,014	549,015	622,986	765,777
North Carolina	261,288	338,750	218,947	297,749	564,578
Oklahoma	....	....	5,000	26,930	18,920
Oregon	10,754	38,429	118,411	235,213	85,330
Pennsylvania	486,008	661,062	829,535	900,530	870,848
Rhode Island	501,698	734,623	710,291	684,952	556,364
South Carolina	996,084	598,848	476,863	382,428	297,284
South Dakota	99,941	(a)	(a)	900	....
Texas	27,005	60,003	173,325	348,317	132,193
Utah	5,588	1,479	3,803	7,980	13,630
Vermont	1,245,828	1,570,423	1,810,179	2,447,979	2,571,850
Virginia	275,701	282,046	299,335	510,788	452,390
Washington	43,808	147,273	209,095	422,508	681,730
Wisconsin	389,953	369,137	573,391	724,422	825,625
Wyoming	2,810	....	....	557	....
Total	15,976,961	18,264,632	18,436,087	20,015,025	20,637,693

[a] Value of quartzite included in sandstone.

The following table shows the value of the trap produced in the United States in 1904 and 1905, by States and uses:

Value of trap produced in the United States in 1904 and 1905, by States and uses.

1904.

State.	Building.	Paving.	Crushed stone.			Other.	Total.
			Road making.	Railroad ballast.	Concrete.		
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

1905.

State.	Building.	Paving.	Road making.	Railroad ballast.	Concrete.	Other.	Total.
California	$2,051	$51,538	$226,489	$29,243	$197,249	$32,918	$539,488
Connecticut	5,709	948	173,823	8,067	113,977	11,000	313,524
Massachusetts	18,080		272,306	905	117,800	2,919	412,010
New Jersey	9,496	57,301	483,529	53,892	147,333	6,400	757,951
New York	14,400	37,000	444,552	69,600	65,800		631,352
Pennsylvania	5,842	3,461	162,112	68,669	142,760	37,385	420,229
Total	55,578	150,248	1,762,811	230,376	784,919	90,622	3,074,554

From this table it will be seen that the value of trap increased from $2,823,546, in 1904, to $3,074,554, in 1905, a gain of $251,008.

Connecticut, Massachusetts, and New York increased in value of output, and California, New Jersey, and Pennsylvania decreased.

The following table shows the number and value of paving blocks produced in 1904 and 1905, by States:

Number and value of paving blocks produced in 1904 and 1905, by States.

State.	Paving blocks.			
	1904.		1905.	
	Number.	Value.	Number.	Value.
Arkansas			11,425	$457
California	5,534,250	$252,054	6,504,735	250,801
Colorado	53,150	4,000		
Connecticut	1,464,656	49,354	1,045,215	43,931
Delaware	366,475	13,031	183,150	6,836
Georgia	6,677,265	250,896	7,946,000	296,750
Maine	9,808,465	426,463	8,188,596	324,858
Maryland	983,575	46,864	869,000	38,900
Massachusetts	5,678,562	320,714	6,594,650	270,308
Minnesota	1,004,325	66,000	1,487,496	98,530
Missouri	697,852	31,786	1,529,364	69,640
Montana	60,000	3,000	50,000	3,500
New Hampshire	1,892,260	65,151	2,084,202	76,822
New Jersey	1,246,100	28,535	1,935,607	58,322
New York	330,000	15,500	420,800	20,600
North Carolina	417,700	15,807	1,139,675	48,234

Number and value of paving blocks produced in 1904 and 1905, by States—Continued.

State.	Paving blocks.			
	1904.		1905.	
	Number.	Value.	Number.	Value.
Oregon	190,000	$7,000	2,000	$80
Pennsylvania	677,688	30,643	820,982	35,026
Rhode Island	1,138,190	47,823	1,503,794	82,641
South Carolina	153,825	5,945	348,500	9,604
Texas			5,000	250
Vermont	382,758	14,745	413,898	16,628
Virginia	1,032,200	30,966	913,440	19,220
Washington	100,000	3,000	14,000	420
Wisconsin	4,277,333	254,051	6,395,236	361,515
Total	44,176,629	1,983,328	50,406,765	2,133,873

From this table it will be seen that the number and value of paving blocks increased from 44,176,629 blocks, valued at $1,983,328, in 1904, to 50,406,765 blocks, valued at $2,133,873, in 1905, an increase of 6,230,136 in number and of $150,545 in value. The average value per thousand was $44.90 in 1904, and $42.33 in 1905.

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 price 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.

GRANITE PRODUCTION IN INDIVIDUAL STATES.

ARIZONA.

As in previous years, the output of granite in Arizona is from near Phoenix, Maricopa County, and amounted to $3,700 in 1905, as compared with $2,500 in 1904.

ARKANSAS.

The value of the output of granite in Arkansas in 1904 was $52,616, and in 1905 $90,312, an increase of $37,696. The greater part of the stone quarried was crushed.

CALIFORNIA.

There was a decrease of $41,512 in the value of granite, trap rock, and basalt quarried in California in 1905, as compared with 1904; the figures for 1904 were $1,742,330, and for 1905, $1,700,818. The decrease was in the value of building stone and in stone used for breakwater, included in stone sold "rough for other purposes." The trap rock and basalt included in the total value amounted to $561,915 in 1904, and to $539,488 in 1905, a decrease of $22,427.

COLORADO.

The output of granite in Colorado in 1905 was $73,802, of which the greater part was for monumental work and curbing. This includes some lava stone as well as true granite.

CONNECTICUT.

An increase of $95,104 marks the Connecticut granite production in 1905, as compared with 1904. The figures for 1905 were $949,888, and for 1904, $854,784. These figures include trap rock valued at $313,524 in 1905, and at $296,450 in 1904, an increase of $17,074 for 1905.

DELAWARE.

A gradual cessation of quarrying at Bellevue of stone for breakwater work in the Delaware River has caused the decrease in the Delaware granite output noted in the past few years. In 1904 the output was valued at $245,272, and in 1905 at $178,428, a decrease of $66,844.

GEORGIA.

There was an increase of $28,741 in the granite output of Georgia in 1905 as compared with 1904, the figures for 1905 being $971,207, and for 1904, $942,466. Building, paving blocks, stone for curbing, and crushed stone are the chief uses of this stone.

HAWAII.

The stone quarried on the Hawaiian Islands and used principally as crushed stone for road building and concrete is lava stone.

The value of this stone reported in 1904 was $22,042, and in 1905, $33,550, an increase of $11,508. Doubtless this represents but a portion of the stone quarried on the islands.

IDAHO.

The small output of granite from Idaho in 1905 was quarried near Rathdrum, Kootenai County, and near Lewiston, Nez Perce County.

INDIAN TERRITORY.

The granite output of Indian Territory amounted in value to $1,500 in 1905. The quarries are near Tishomingo and Troy.

MAINE.

In 1904 Maine ranked third as a granite-producing State; but in 1905, with an increase in value of $313,286, from $2,400,509 in 1904 to $2,713,795 in 1905, this State took first place, outranking Massachusetts and Vermont by a small lead. The chief increase was in the value of building stone sold by the quarrymen. This, including rough and dressed stone, was valued at $2,083,089 in 1905, and at $1,719,091 in 1904, an increase of $363,998. The paving-block industry is the next in importance, and this in 1905 showed a slight decrease from 9,808,465 blocks, valued at $426,463, in 1904 to 8,188,596 blocks, valued at $324,858, in 1905, a difference of 1,619,869 blocks, valued at $101,605.

MARYLAND.

There was an increase of $141,577 in the value of the Maryland granite production in 1905, from $815,471 in 1904 to $957,048 in 1905. The output from this State includes granite, trap rock, and gneiss. The increase of value was chiefly in the quantity and value of rough building stone sold.

MASSACHUSETTS.

In 1904 Massachusetts took first rank in the list of granite-producing States, but in 1905 Massachusetts ranked second, after Maine; and Vermont, ranking second in 1904, ranked third in 1905, closely following Massachusetts in value of output.

Both the Maine and the Vermont products, however, included more true granite than the Massachusetts product, which included a large quantity of trap rock, chiefly used for crushed stone. The total value of the output of Massachusetts in 1905 was $2,663,329, as against $2,868,305 in 1904, a decrease of $204,976.

Included in these figures are trap rock valued at $313,557 in 1904 and at $412,010 in 1905, an increase of $98,453.

The consolidation of several firms and the unsettled state of affairs at some of the quarries contributed to the total decrease in this State.

MINNESOTA.

The value of the granite output in Minnesota in 1905 was $481,908; in 1904 it was $405,956, an increase of $75,952 in 1905.

MISSOURI.

Missouri granite increased in value of output $24,863 in 1905, from $155,716 in 1904 to $180,579 in 1905.

MONTANA.

Granite valued at $126,430 was produced in Montana in 1905, as against $33,890 in 1904, an increase of $92,540. The increase was in the stone used for building and monumental work. The output was from Welch, Jefferson County, and Baxendale and Helena, Lewis and Clark County.

NEW HAMPSHIRE.

New Hampshire, although known as the "granite" State, ranks ninth in the list of granite-producing States. The chief centers of production are Concord and Suncook, Merrimac County, producing principally monumental stone; Marlboro, Troy, and Fitzwilliam, Cheshire County, building stone; Milford, Hillsboro County, building and monumental stone, and Redstone, Carroll County, mostly building stone.

The output in 1905 was $838,371, as compared with $927,487 in 1904, a decrease of $89,116.

NEW JERSEY.

The trap rock and granite quarried in New Jersey in 1905 was valued at $834,709 and at $833,518 in 1904, practically the same for the two years. The greater part of this output is trap rock, which was valued at $757,951 in 1905, as compared with $796,321 in 1904, a decrease of $38,370.

NEW YORK.

The output of granite, including trap rock, from New York in 1905 was $765,777; in 1904 it was $622,986, an increase of $142,791. The greater portion of this output is trap rock, which was valued at $426,301 in 1904 and $631,352 in 1905, an increase of $205,051. The increase was in the stone dressed for building and the crushed stone.

NORTH CAROLINA.

The granite output of North Carolina in 1905 amounted in value to $564,578. This, in comparison with the value for 1904, $297,749, showed the large increase of $266,829. This increase was principally in the stone sold rough and dressed for building purposes and in stone made into paving blocks. The producing localities are Asheville and Montford, Buncombe County; Balfour, Henderson County; Rockliff, Polk County; Granite Quarry, Faith, Salisbury, and Barber, Rowan County; Old Fort, McDowell County; Advance, Davie County; Gastonia, Gaston County; Greystone, Vance County; Mt. Airy, Surry County, and Wise, Warren County.

OKLAHOMA.

Although represented by a smaller output in 1905 than in 1904, the interest in this State in the granite quarries at Granite, Greer County, and at Ponca City, Kay County, is still very active, and further developments of the region seem well assured. The output in 1905 was valued at $18,920; in 1904, at $26,930, a decrease of $8,010.

OREGON.

The Oregon output, besides granite, includes some trap rock, basalt, and tufa. The value reported in 1905 was $85,330; in 1904, $235,213, a decrease of $149,883. This decrease was on account of less stone quarried in this State for the jetty at the mouth of the Columbia River.

PENNSYLVANIA.

The Pennsylvania output is about equally divided between granite and trap rock; the granite includes gneiss and a small quantity of serpentine. The total output for

1905 was $870,848, which, compared with $900,530 for 1904, shows a decrease of $29,682. The trap rock included in the total for 1905 was valued at $420,229, as against $429,002 for 1904, a slight decrease of $8,773.

RHODE ISLAND.

The output of granite in Rhode Island in 1905 was $556,364; in 1904, $684,952, a decrease of $128,588.

SOUTH CAROLINA.

There was a decrease of $85,144 in the value, $297,284, of the granite output reported from South Carolina in 1905 in comparison with $382,428, the figures for 1904.

TEXAS.

Less granite quarried for the sea wall at Galveston caused a decrease of $216,124 in the granite output of Texas, from $348,317 in 1904 to $132,193 in 1905.

UTAH.

The value of the granite output of Utah increased from $7,980 in 1904 to $13,630 in 1905.

VERMONT.

Vermont, although showing an increase in value of granite output, fell from second to third place, being exceeded by Maine and Massachusetts. The value in 1905 was $2,571,850; in 1904 $2,447,979, an increase of $123,871. It is noticeable that the value of rough and dressed monumental stone decreased, while the value of rough and dressed building stone increased. The value of the monumental stone was $1,249,774 in 1905 and $1,412,887 in 1904 a decrease of $163,113. The value of building stone was $995,949 in 1904 and $1,282,079 in 1905, an increase of $286,130.

VIRGINIA.

The output of granite in Virginia in 1905 was $452,390; in 1904, $510,788, a decrease of $58,398.

WASHINGTON.

The increase of $259,222, from $422,508 in 1904 to $681,730 in 1905, was occasioned by the quarrying of a large quantity of stone in this State for use at the jetty in the mouth of the Columbia River.

SANDSTONE.

The total value of the sandstone output in the United States in 1905 was $10,006,774, as against $10,273,891 in 1904, a decrease of $267,117 for 1905. In 1904 there was a decrease of $988,368 as compared with 1903, when the value was $11,262,259. Previous to these years the value of the sandstone output had increased. Bluestone, valued in 1905 at $1,931,625 and at $1,791,729 in 1904, quarried in New York and Pennsylvania, is included in the total and shows an increase of $139,896.

The decrease in the total was in the value of building stone, which, including dressed and rough stone, declined $459,969, from $5,162,158 in 1904 to $4,702,189 in 1905.

Rubble, curbstone, and crushed stone also decreased in value, while the other products showed some increase.

Pennsylvania, the first State in value of production, decreased in value from $2,641,510 in 1904 to $2,487,939 in 1905, a loss of $153,571.

Ohio, which for four years has held second rank in the sandstone-producing States, ranked third in 1905, the value of $1,744,472 in 1905 being exceeded by New York with a value of $1,831,756.

Concrete blocks, brick, and no demand for building stone, as well as scarcity and high price of labor, were the chief factors causing the decrease in the total output.

The following tables show the value of the sandstone production of the United States in 1904 and 1905, by States and uses:

Value of sandstone produced in the United States in 1904 and 1905, by States and uses.

1904.

State.	Rough building.	Dressed building.	Crushed stone. Road-making.	Crushed stone. Railroad ballast.	Crushed stone. Concrete.	Ganister.	Riprap.
Alabama							$6,796
Arizona	$19,050	$14,860			$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
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	41,494	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		20,518	4,591
Wyoming	14,247	10,650	2,460		249		
Total	2,228,727	2,933,431	338,287	440,442	240,722	136,957	270,148

Value of sandstone produced in the United States in 1904 and 1905, by States and uses—Continued.

1904.

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
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	10,273,891

Value of sandstone produced in the United States in 1904 and 1905, by States and uses—Continued.

1905.

State.	Rough building.	Dressed building.	Crushed stone.			Ganister.	Riprap.
			Road making.	Railroad ballast.	Concrete.		
Alabama	$100						$21,507
Arizona		$16,083			$229		41,334
Arkansas	6,372	6,229	$900		27,600		540
California	57,823	456,350	92,605	$12,202			
Colorado	209,891	20,590			3,833	$32,000	1,850
Connecticut	51,382	5,789					45
Idaho	12,940	4,300					200
Illinois	15,324	7,875	150			480	408
Indiana	5,575	6,200					1,500
Indian Territory	300	1,250					
Iowa	7,165	422	300		50		113
Kansas	30,868	4,838				100	35
Kentucky	77,117	28,225	12,500	111,920			1,047
Maryland	4,904			80		8,000	
Massachusetts	55,964	35,269	157,244		115,924		
Michigan	64,056	36,035					
Minnesota	24,610	58,853	4,000	140	12,800		4,236
Missouri	15,890	4,039	75		35		1,568
Montana	9,882	30,072			1,200		612
Nebraska	108						
Nevada	1,500						
New Jersey	161,200	27,868	7,650		9,100		375
New Mexico	1,820	3,500		85,000	1,575		
New York	210,760	261,524	5,259	3,500	28,934		23,875
North Carolina	150	3,858					
North Dakota	955	100					
Ohio	405,976	461,135	15,207	2,200	10,785	9,020	37,880
Oklahoma	9,074	1,950	175		185		200
Oregon	520	389	26				100
Pennsylvania	441,768	872,522	46,911	119,392	62,371	122,909	81,455
South Dakota	39,491	65,780	804		12,000		14,701
Tennessee	1,035	5,000	100				
Texas	7,858	18,425		1,500	19,375		46,485
Utah	10,360	1,058					
Virginia	2,000						
Washington	55,695	15,000					3,100
West Virginia	48,887	50,691	5,525	4,273	4,638		395
Wisconsin	42,864	76,160	5,838		375	13,614	4,391
Wyoming	19,086	540		1,750	35		
Total	2,114,270	2,587,919	355,269	341,957	311,044	186,123	290,952

Value of sandstone produced in the United States in 1904 and 1905, by States and uses— Continued.

1905.

State.	Rubble.	Paving.	Flagging.	Curbing.	Other.	Total.
Alabama	$3,500					$28,107
Arizona	7,912					65,558
Arkansas	7,950	$300	$1,550	$6,720		58,161
California	37,437			1,350	$27,901	685,668
Colorado	24,712	16,169	91,750	46,352	5,882	453,029
Connecticut	5,402					62,618
Idaho	4,825					22,265
Illinois	2,360	2,100	118	300		29,115
Indiana	1,555		279	312		15,421
Indian Territory	648					2,198
Iowa	640		250	75	320	9,335
Kansas	1,159	40	25,139	3,655	13,783	79,617
Kentucky	9,330	40	34,650	2,750	3,000	280,579
Maryland						12,984
Massachusetts	2,660	400				367,461
Michigan	10,332				12,700	123,123
Minnesota	35,569	131,883	7,200	14,812	537	294,640
Missouri	3,013	30	288	128	2,620	27,686
Montana	3,218				132	45,116
Nebraska					12	120
Nevada						1,500
New Jersey	50,000		13,000	12,200	13,326	291,719
New Mexico	2,327		300		7,000	101,522
New York	15,347	378,455	354,216	395,124	154,762	1,831,756
North Carolina	475					4,483
North Dakota						1,055
Ohio	60,672	1,600	463,757	270,489	5,751	1,744,472
Oklahoma	780	175	160	215		12,914
Oregon					194	1,229
Pennsylvania	117,733	107,854	227,181	269,848	14,995	2,487,939
South Dakota	15,262	43,440	270	1,660		193,408
Tennessee	2,500			50	30	8,715
Texas	5,788	4,000		3,360	16,490	123,281
Utah	13,900	10,316	740	6,480	575	43,429
Virginia						2,000
Washington	6,435	44,680				124,910
West Virginia	46,565			7,475	2,860	171,309
Wisconsin	17,061			1,248	190	161,741
Wyoming	10,851	200	500	380	249	33,591
Total	527,918	741,682	1,221,348	1,044,983	283,309	10,006,774

The following table shows the value of the sandstone production in the United States from 1901 to 1905, inclusive, by States:

Value of sandstone production in the United States, 1901–1905, by States.

State.	1901.	1902.	1903.	1904.	1905.
Alabama	$8,680	$42,706	$42,933	$12,788	$28,107
Arizona	202,500	107,910	526,875	91,960	65,558
Arkansas	62,825	85,917	61,172	63,950	58,161
California	301,028	462,328	762,327	735,662	685,668
Colorado	237,331	366,161	389,132	281,142	453,029
Connecticut	146,814	128,579	119,417	117,696	62,618
Georgia	....	1,250	....	....	....
Idaho	20,843	13,777	11,856	9,320	22,265
Illinois	12,884	32,200	26,293	47,377	29,115
Indiana	28,334	37,593	32,651	22,681	15,421
Indian Territory	....	....	....	....	2,198
Iowa	14,341	15,061	19,011	9,300	9,335
Kansas	49,901	105,509	102,128	130,516	79,617
Kentucky	108,259	128,470	93,742	93,622	280,579
Louisiana	....	....	....	8,315	....
Maryland	4,546	15,405	2,170	8,998	12,984
Massachusetts	247,310	487,366	372,478	320,861	367,461
Michigan	174,428	188,073	121,350	74,868	123,123
Minnesota	246,685	347,472	363,262	319,209	294,640
Missouri	42,170	56,990	49,402	44,455	27,686
Montana	58,439	85,152	68,036	64,232	45,116
Nebraska	515	168	1,067	142	120
Nevada	....	6,115	2,370	10,558	1,500
New Jersey	244,512	406,726	364,337	236,426	294,719
New Mexico	....	12,291	7,510	133,390	101,522
New York	[a]1,331,327	[a]1,408,699	[a]1,756,561	[a]1,755,524	[a]1,831,756
North Carolina	11,682	4,825	600	250	4,483
North Dakota	....	....	....	....	1,055
Ohio	1,999,180	2,078,754	1,793,379	1,808,062	1,744,472
Oklahoma	....	25,309	6,500	2,995	12,914
Oregon	531		2,912	6,186	1,229
Pennsylvania	[a]2,063,082	[a]2,800,108	[a]3,255,073	[a]2,641,510	[a]2,487,939
South Dakota	17,647	110,789	163,067	338,970	193,408
Tennessee	10,342	7,670	20,649	24,868	8,715
Texas	111,568	165,565	114,381	209,313	123,281
Utah	38,919	105,011	71,279	70,168	43,429
Virginia	5,303	2,500	4,471	13,522	2,000
Washington	89,174	30,725	47,430	88,185	124,910
West Virginia	103,010	423,532	252,204	287,381	171,309
Wisconsin	90,425	207,086	142,445	158,503	161,741
Wyoming	54,145	90,691	91,849	30,986	33,591
Total	8,138,680	10,594,483	11,262,259	10,273,891	10,006,774

[a] Includes bluestone.

The following table shows the value and uses of the bluestone produced in New York and Pennsylvania in 1904 and 1905:

Value and uses of bluestone produced in New York and Pennsylvania in 1904 and 1905.

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

1905.

State.	Building purposes.	Flagging.	Curbing.	Crushed stone.	Other purposes.	Total value.
New York	$351,005	$330,566	$273,534		$150,359	$1,105,464
Pennsylvania	292,062	216,435	157,391	$38,877	121,396	826,161
Total	643,067	547,001	430,925	38,877	271,755	1,931,625

SANDSTONE PRODUCTION IN INDIVIDUAL STATES.

ALABAMA.

The sandstone quarried in Alabama in 1905 was from Generys Gap, near Bamford, Shelby County; Short Creek, Jefferson County; and Tuscaloosa, Tuscaloosa County; and was principally used for riprap in improvement work carried on by the Government.

The output was valued at $12,788 in 1904 and at $28,107 in 1905, an increase of $15,319.

ARIZONA.

The sandstone quarried in Arizona was chiefly used for riprap and bridge work on the Santa Fe Railroad, the output being not so large as in 1904.

ARKANSAS.

The sandstone quarried in Arkansas was from Lamar and Clarksville, Johnson County; near Mena, Polk County; Fayetteville, Washington County; Fort Smith, Sebastian County; near Morrillton, Conway County; and Russell, White County. The output was, however, not great, being valued at $58,161 in 1905 and at $63,950 in 1904.

CALIFORNIA.

The sandstone quarried in California in 1905 decreased, as compared with 1904, from $735,662 to $685,668 in 1905, a loss of $49,994.

COLORADO.

The value of the sandstone produced in Colorado in 1905 was $453,029, an increase of $171,887 as compared with $281,142 in 1904. This increase was due to the general demand for all classes of stone rather than to any specific cause. The stone is chiefly building, curbstone, and flagstone, and is quarried at Arkins, Loveland, Fort Collins, and Stout, Larimer County; Lyons, Nolan, and Boulder, Boulder County; Canyon, Fremont County; Colorado City, El Paso County; Montrose, Delta County; Durango, La Plata County; Granite, Chaffee County; Osier, Conejos County; Peachblow, Eagle County; near Pueblo, Pueblo County; and at Steamboat Springs, Routt County. A small quantity of this stone is used for tombstone work.

CONNECTICUT.

The sandstone quarried in Connecticut in 1905 was from Tariffville and Avon, Hartford County; East Haven, New Haven County; and Portland, Middlesex County. The output was $117,696 in 1904 and $62,618 in 1905, a decrease of $55,078.

IDAHO.

Idaho increased in value of sandstone production from $9,320 in 1904 to $22,265 in 1905, a gain of $12,945. The stone is quarried at Boise, Ada County; Preston (Glendale), Oneida County; and Goshen, Idaho Falls, and Prospect, Bingham County.

ILLINOIS.

The output of sandstone from Illinois was valued at $47,377 in 1904 and at $29,115 in 1905, a decrease of $18,262. The decrease was for the most part in the value of crushed stone.

INDIANA.

There was a decrease of $7,260 in the sandstone output of Indiana, or from $22,681 in 1904 to $15,421 in 1905. This stone is quarried at Attica, Warren County, and at Cannelton, Perry County.

INDIAN TERRITORY.

The sandstone reported from Indian Territory in 1905 was quarried at Tulsa and Boynton. The output was small, being valued at $2,198.

IOWA.

The sandstone output in Iowa was valued at $9,335 in 1905 as compared with $9,300 in 1904.

KANSAS.

The sandstone output in Kansas in 1905 was $79,617 as compared with $130,516 in 1904, a decrease of $50,899. The decrease was in the curbstone and crushed stone.

KENTUCKY.

The value of sandstone quarried in Kentucky in 1905 showed a very large increase from $93,622 in 1904 to $280,579 in 1905, or $186,957. The output is from Barboursville, Knox County; Farmers and Freestone, Rowan County; Cedar Bluff, near Ohara, Caldwell County; Langford and Wildie, Rockcastle County; Quincy, Lewis County; and Williamsburg, Whitley County. Rowan and Rockcastle counties furnished the greater part of the output. The increase was in the value of building and crushed stone, a large quantity of the latter being used as ballast by the Illinois Central Railroad.

LOUISIANA.

There was no output reported for Louisiana in 1905.

MARYLAND.

Maryland reported an output of sandstone valued at $12,984 in 1905 against $8,998 in 1904, an increase of $3,986. This stone was quarried at Bloomington, Garrett County; Cumberland, Allegany County; and near Taneytown, Carroll County.

MASSACHUSETTS.

Massachusetts reported sandstone valued at $367,461 in 1905 against $320,861 in 1904, an increase of $46,600. The increase was in value of crushed stone used for concrete.

MICHIGAN.

The value of sandstone reported from Michigan in 1905 was $123,123, an increase of $48,255 over $74,868 in 1904. The output was from near Calumet in Keweenaw

County; Grind Stone City, Huron County; Holland, Ottawa County; Jacobsville, Houghton County; Marquette, Marquette County; L'Anse, Baraga County; and Ottawa Lake, Monroe County. Besides the stone above reported, a considerable quantity quarried at Grind Stone City and Port Austin was made into grindstones.

MINNESOTA.

The sandstone output in 1905 from Minnesota was valued at $294,640; in 1904 at $319,209, a decrease of $24,569. The stone is used for building, rubble, and paving. It is quarried at Banning and Sandstone, Pine County; Cortland and New Ulm, Nicollet County; Fond du Lac, St. Louis County; Jasper, Pipestone County; Jordan, Scott County; and Luverne, Rock County.

Most of this stone is a quartzite commonly known as "Jasper" or "red granite."

MISSOURI.

A small quantity of sandstone is quarried in this State each year. The output was valued at $44,455 in 1904, and at $27,686 in 1905, a decrease of $16,769. The greater part of the stone is quarried at Miami Station, Carroll County, and at Warrensburg, Johnson County.

MONTANA.

The output of sandstone from Montana in 1905 was valued at $45,116 and at $64,232 in 1904, a decrease of $19,116. The stone was quarried near Billings and Columbus, Yellowstone County; near Bozeman, Gallatin County; and at Fields and Great Falls, Cascade County.

NEBRASKA.

A very small quantity of sandstone is quarried in Nebraska annually, the value for 1905 being $120.

NEVADA.

The small quantity of sandstone reported from Nevada in 1905 was valued at $1,500.

NEW JERSEY.

The value of sandstone quarried in New Jersey in 1905 was $294,719 against $236,426 in 1904, an increase of $58,293. This value includes some bluestone quarried near Quarryville, Sussex County; Kingston, Somerset County; and Princeton, Mercer County.

The other localities of production are Wilburtha, Mercer County; Avondale and West Orange, Essex County; Closter, North Arlington, and Ridgefield, Bergen County; Martinville, Somerset County; Passaic and Paterson, Passaic County; and Stockton, Hunterdon County. Building, rubble, flagstone, and curbstone are the chief uses of this stone.

NEW MEXICO.

The sandstone reported from New Mexico is used chiefly for railroad work, as ballast and bridge masonry. The value reported for 1905 was $101,522 against $133,390 in 1904, a decrease of $31,868.

NEW YORK.

New York ranked second in value of output of sandstone in 1905, exceeding Ohio and being exceeded by Pennsylvania.

The value of the stone quarried in 1905 was $1,831,756 against $1,755,524 in 1904, an increase of $76,232.

The greater part of the value represents bluestone, a variety of sandstone, quarried principally in Albany, Greene, Ulster, Sullivan, Delaware, Broome, Chenango, and Wyoming counties.

The sandstone is quarried chiefly in Orleans County.

Large quantities of the bluestone are quarried by farmers and small quarrymen, who sell it to large buyers at the docks or along the railroads. These buyers prepare it for the market, and a number of them have their own quarries. Building stone in the shape of blocks for sills, coping, lintels, steps, etc., flagstone, and paving stone are the chief uses of this stone.

The total value of the bluestone was $1,105,464 in 1905 and $1,044,314 in 1904, an increase of $61,150.

The sandstone production, not including bluestone, increased from $711,210 in 1904 to $726,292 in 1905, a gain of $15,082.

NORTH CAROLINA.

The value of sandstone reported from North Carolina in 1905 was $4,483; it was from Sanford, Moore County.

NORTH DAKOTA.

Sandstone valued at $1,055 was reported from this State in 1905. It was quarried at Velva, McHenry County, and at Linton, Emmons County.

OHIO.

Ohio took third rank in the list of sandstone-producing States in 1905, being exceeded by Pennsylvania and New York. In 1904 Ohio ranked second, following Pennsylvania.

The total output for 1905 was valued at $1,744,472, as compared with $1,808,062 in 1904, a decrease of $63,590.

This stone is used chiefly for building, rubble, flagstone, and curbstone, with small quantities for the various other uses.

OKLAHOMA.

The output reported from Oklahoma in 1905 was $12,914, as compared with $2,995 in 1904, an increase of $9,919.

OREGON.

The small quantity of sandstone reported from Oregon in 1905 was valued at $1,229.

PENNSYLVANIA.

There was a decrease of $153,571 in the value of the sandstone produced in Pennsylvania, from $2,641,510 in 1904, to $2,487,939 in 1905.

These figures include bluestone valued at $826,161 in 1905 and at $747,415 in 1904, an increase of $78,746. The sandstone decreased from $1,894,095 in 1904 to $1,661,778 in 1905, a decrease of $232,317. Included in the value of sandstone for building stone is a large quantity of stone used for bridge work on railroads, and the decrease in demand for this class of stone caused the decrease in the total for the State.

SOUTH DAKOTA.

The sandstone quarried in this State is mostly quartzite, generally known to the trade as Jasper stone, and often called "red granite." It is quarried at Sioux Falls, East Sioux Falls, Dell Rapids, and Garretson, Minnehaha County. Sandstone is also quarried at Hot Springs, Fall River County; Spearfish and Deadwood, Lawrence

County; Spencer, Hanson County; and Bellefourche, Butte County. There was a large decrease in output in 1905, reported as caused by strikes and other business troubles. The value given for 1905 was $193,408, and for 1904 $338,970.

TENNESSEE.

Sandstone valued at $8,715 was reported from Tennessee in 1905 as against $24,868 in 1904.

TEXAS.

Less stone used in jetty construction near Galveston accounted for the decreased output of sandstone reported from Texas in 1905 as compared with 1904; the value was $209,313 in 1904 and $123,281 in 1905, a decrease of $86,032.

UTAH.

Utah decreased in value of sandstone production $26,739 in 1905 as compared with 1904; the output in 1905 was $43,429 and in 1904 it was $70,168. The demand was reported as good for the stone, but lack of operating facilities decreased the output.

VIRGINIA.

Virginia reported an output valued at $2,000 in 1905 as against $13,522 in 1904, a decrease of $11,522.

WASHINGTON.

There was an increase of $36,725 in the value of the sandstone quarried in Washington, from $88,185 in 1904 to $124,910 in 1905. The operating localities were Bellingham, Whatcom County; Port Angeles, Clallam County; East Sound and Stuart and Waldron islands, San Juan County; Tenino, Thurston County; and Wilkerson, Pierce County.

WEST VIRGINIA.

The sandstone output in West Virginia in 1905 was valued at $171,309, against $287,381 in 1904, a decrease in 1905 of $116,072. The decrease was in the value of building stone. The demand generally was reported as very slight.

WISCONSIN.

There was a small increase in the value of sandstone in Wisconsin from $158,503 in 1904 to $161,741 in 1905, a gain of $3,238. The building stone and rubble increased in value, and the other products decreased.

WYOMING.

Wyoming reported sandstone valued at $33,591 in 1905, as compared with $30,986 in 1904, an increase of $2,605.

MARBLE.

There was a large increase, from $6,297,835 to $7,129,071, or $831,236, in the value of the marble quarried in 1905, as compared with 1904. The greater part of this increase was from the State of Vermont, although California, Georgia, Maryland, New York, Pennsylvania, Tennessee, and Washington each showed also an increase in value of output. The increase was for building stone and for stone used in the interior of buildings, the dressed monumental stone declining somewhat in value.

The total output includes a small quantity of serpentine in Georgia, Washington, and Pennsylvania quarried and sold as marble, and a small quantity of so-called "onyx" marble, included on account of its similarity of composition and use.

Notwithstanding the enormous quantity of marble capable of being quarried in the United States from the well-developed deposits, and the large number of known undeveloped deposits, a considerable quantity of marble is imported into this country, chiefly from Italy, for statuary and interior decoration, the value of which in 1904 was $1,186,452 and in 1905 $1,231,700, an increase of $45,248, as shown in the table of imports and exports on p. 16.

Onyx, valued at $60,518 in 1905 and at $75,460 in 1904, a loss of $14,942, was also imported, the greater part coming from Mexico.

The exports of marble were valued at $265,023 in 1905 and $203,086 in 1904, an increase of $61,937.

The following table shows the value of the marble produced in the United States in 1904 and 1905, by States and uses:

Value of the marble product, 1904 and 1905, by States and uses.

1904.

State.	Rough.			Dressed.					Total.
	Building.	Monumental.	Other purposes.	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	(b) 59,916
Total	1,284,741	1,116,643	197,668	988,671	1,211,389	21,554	1,257,963	219,206	6,297,835

(a) Included in "Other States."
(b) Includes Alabama, Alaska, Arizona, Arkansas, Connecticut, and Missouri.

1905.

State.	Rough. Building.	Rough. Monumental.	Rough. Other purposes.	Dressed. Building.	Dressed. Monumental.	Dressed. Ornamental.	Dressed. Interior decoration.	Dressed. Other purposes.	Total.
Alaska					700	10			710
Arkansas	750	250							1,000
California	4,390	2,075	1,300	5,000	7,575	200	75,000		95,540
Georgia	370,047	275,000	72,500	45,421	11,582				774,550
Maryland	7,168		3,930	90,782			36,524		138,404
Massachusetts	11,622		6,828	15,915			131,995		166,360
New Mexico	300			1,500	400				2,200
New York	214,023	80,916	13,677	391,037	96,068				795,721
Pennsylvania	8,986	750	4,200	59,951	24,000				97,887
Tennessee	237,399	830	500	4,000	11,000		323,500	5,000	582,229
Utah	600				550				1,150
Vermont	903,905	740,117	25,479	554,844	1,015,904	13,433	1,055,632	101,506	4,410,820
Washington							60,000		60,000
Wyoming					2,500				2.500
Total	1,759,190	1,099,938	128,414	1,168,450	1,170,279	13,643	1,682,651	106,506	7,129,071

The following table shows the value of the marble produced in the United States from 1901 to 1905, inclusive, by States:

Value of marble produced in the United States, 1901–1905, by States.

State.	1901.	1902.	1903.	1904.	1905.
Alabama	....	(a)	(a)	(a)	....
Alaska	$4,500	....	....	(a)	$710
Arizona	300	....	(a)	(a)	....
Arkansas	300	(a)	....	(a)	1,000
California	6,642	$92,298	$78,329	$87,659	95,540
Connecticut	....	(a)	(a)	(a)	....
Georgia	936,549	660,517	565,605	690,714	774,550
Maryland	68,100	(a)	83,672	73,814	138,404
Massachusetts	126,546	165,489	154,228	183,388	166,360
Missouri	2,100	....	(a)	(a)	....
Montana	1,500	(a)	....	....	....
New Mexico	10,600	(a)	(a)	4,250	2,200
New York	379,159	577,298	748,160	565,987	795,721
North Carolina	....	....	4,365	2,741	....
Oregon	500	....	....	....	....
Pennsylvania	157,547	160,423	93,200	90,390	97,887
Tennessee	494,637	518,256	485,905	505,259	582,229
Utah	320	(a)	3,200	3,950	1,150
Vermont	2,753,583	2,628,164	3,011,505	4,004,669	4,410,820
Washington	22,816	61,176	40,117	23,098	60,000
Wyoming	....	....	3,100	2,000	2,500
Other States	....	[b]180,561	[c]91,300	[d]59,916	....
Total	4,965,699	5,044,182	5,362,686	6,297,835	7,129,071

[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 1901, 1902, 1903, 1904, and 1905 was put:

Distribution and value of output of marble in 1901, 1902, 1903, 1904, and 1905, among various uses.

Use.	1901.	1902.	1903.	1904.	1905.
Sold by producers in rough state	$591,667	$2,275,429	$2,454,263	$2,599,052	$2,987,542
Dressed for building	1,236,023	1,038,302	1,111,072	988,671	1,168,450
Ornamental purposes	126,576	7,300	51,359	21,554	13,643
Dressed for monumental work	1,948,892	956,870	1,062,339	1,211,389	1,170,279
Interior decoration in buildings	1,008,482	679,913	663,553	1,257,963	1,682,651
Other uses	54,059	86,368	20,100	219,206	106,506
Total	4,965,699	5,044,182	5,362,686	6,297,835	7,129,071

MARBLE PRODUCTION IN INDIVIDUAL STATES.

ALABAMA.

The marble quarry operations in this State in 1905 were confined to developing deposits, but at the principal deposit near Sylacauga, Talladega County, the company reports that it is, in 1906, actively quarrying with six channeling machines and ten gang saws at its sawing plant.

ALASKA.

Only a small quantity of Alaskan marble was put upon the market in 1905, and that was chiefly for the local monumental trade. At Baldwin, Prince of Wales Island, the American Coral Marble Company has done considerable development work in the years 1904 and 1905, but has not sold any marble as yet. The Alaska Marble Company at Shakan, Prince of Wales Island, has been constructing buildings, erecting machinery, building a tram railroad and a wharf for deep-sea vessels, and expects to make shipments in the near future. The El Capitan Mining Company, near Shakan, on the northwest coast of Prince of Wales Island, has shipped some stone, but was not operating in 1905.

The Ham Island Marble Company on Ham Island, near Wrangell, has operated on a small scale and put some marble on the market.

At Klawak Pass, near Shakan, the "Fox Island" deposit has been exploited to some extent but with no commercial output.

ARIZONA.

There was no marble or onyx reported from Arizona in 1905.

ARKANSAS.

The small quantity of marble quarried in Arkansas in 1905 was from near Segal, Baxter County. The other deposits were not operated on account of lack of demand, lack of capital to work them, and lack of transportation facilities.

CALIFORNIA.

There was an increase in the value of the marble output of California in 1905 from $87,659 in 1904 to $95,540 in 1905, or $7,881. The greater part of this marble is used in the interior decoration of buildings, which increased in value from $66,620 in 1904 to $75,000 in 1905, or $8,380. The localities of operation were Colton, San Bernardino County; Columbia, Tuolumne County; Healdsburg, Sonoma County; Riverside, Riverside County; near Sutter Creek, Amador County; and Inyo, Inyo County.

COLORADO.

The operations in the marble deposits of Colorado in 1905 were, as in 1904, limited to development work, chiefly at Marble, Gunnison County, and Salida, Chaffee County.

CONNECTICUT.

There was no work done in the marble quarries in Connecticut in 1905 because of litigation concerning the leases.

GEORGIA.

The value of the marble output in Georgia in 1905 was $774,550; in 1904, $690,714, an increase of $83,836. This stone is sold rough to the manufacturers chiefly for building and monumental stone. The output comes from Marble Hill and Tate, Pickens County, and also includes some serpentine from Holly Springs, Cherokee

County. A new marble property is reported near Ellijay, Gilmer County, and although this has not been opened or tested to any extent as yet, a company expects to do some development work in 1906.

IDAHO.

No work has been done at the onyx and marble properties in Idaho in 1905.

INDIAN TERRITORY.

The Southern Marble Company at Marble City, Ind. T., reports that it has as yet delivered no stone, but that it is rapidly putting the quarry into shape and hopes to market the stone at an early date.

MARYLAND.

Considerable interest was evinced in the marble properties of Maryland in 1905; and quarries at Eakles Mills, Washington County, and Cockeysville, Baltimore County, were in operation, and deposits at Summerfield, Baltimore County, recently located, and at Whitehall, Baltimore County, are being developed. The output increased from $73,814 in 1904 to $138,404 in 1905, or $64,590.

MASSACHUSETTS.

There was a decrease in the value of marble quarried in Massachusetts from $183,388 in 1904 to $166,360 in 1905, or $17,028. A new company, the White Marble and Terazzo Company, started operations at Lee, and the Chester-Goodale quarry at Sheffield was taken over by the Berkshire Hills Company.

MISSOURI.

In 1905, the output of stone sold as marble was not kept separate from the limestone production, and it is therefore included in that report.

MONTANA.

Development work continued in the onyx and marble deposits in this State, especially at the quarry on Dempsey Creek near Race Track Station, Powell County, where water power and gang saws are installed in the operating plant, and considerable stripping has been done.

NEVADA.

Marble deposits near Mina and Luning, Esmeralda County, have been prospected during 1905 with a view to future operations.

NEW MEXICO.

But little has been done in the New Mexico onyx quarries in 1905, lack of transportation checking development of deposits.

NEW YORK.

The output of marble in New York increased from $565,987 in 1904 to $795,721 in 1905, or $229,734. The increase was in the stone sold for building purposes. The principal quarries are at Gouverneur, St. Lawrence County, South Dover, Dutchess County, and Tuckahoe, West Chester County.

NORTH CAROLINA.

No marble was marketed from the North Carolina marble deposits in 1905.

PENNSYLVANIA.

The marble production of Pennsylvania in 1905, including a small quantity of serpentine, was valued at $97,887, as against $90,390 in 1904, an increase of $7,497.

TENNESSEE.

The output of marble in Tennessee in 1905 was $582,229; in 1904 it was $505,259, an increase of $76,970 for 1905.

TEXAS.

There are several deposits of onyx marble reported from Texas, but none of the material has been marketed.

UTAH.

The output of marble and onyx reported from Utah was from near Newhouse, Beaver County, and Provo City, Utah County. Development and assessment work was done at other deposits, but there was no output.

VERMONT.

The increase of $406,151 in the value of the marble output in Vermont in 1905 from $4,004,669 in 1904 to $4,410,820 in 1905 accounts largely for the total increase in the United States. This stone is used chiefly for building and monumental purposes, with a large quantity for interior work in buildings.

WASHINGTON.

Development and assessment work was done on marble prospects in Washington in 1905, but little marble was placed on the market.

WYOMING.

But little beyond development and assessment work was done on the marble and onyx deposits in Wyoming in 1905.

LIMESTONE.

The limestone included in the following report does not include the limestone burned into lime nor the limestone used in the manufacture of Portland cement, the value of the limestone used for those purposes being incorporated in the reports on those subjects. The stone reported as sold to lime burners is largely stone sold to sugar refiners to be burned into lime and used in the process of beet-sugar refining, especially in the States of California, Colorado, Utah, and Michigan. In other States the stone thus described is sold to be burned for chemical purposes and to farmers to be burned for use of lime on farms. In some cases large operators sell their waste stone for this purpose. Under the heading "Sold for other purposes," is included stone sold chiefly for chemical purposes and for use in the manufacture of glass.

In 1905 the total output was largely increased by the quantity of stone used by blast furnaces. The use of artificial stone in blocks for building was reported as a check on the limestone trade.

The total value, however, not including lime or cement stone, increased $3,846,246—from $22,178,964 in 1904 to $26,025,210 in 1905. In 1904 there was a decrease of $193,145; in 1903 there was an increase of $1,746,724, and in 1902 the increase was $2,692,542.

The largest increase was in the value of furnace flux, which was $4,702,768 in 1904, and $7,004,265 in 1905, an increase of $2,301,497.

The value of crushed limestone in 1905 was $10,487,638; as against $9,558,626 in 1904, an increase of $929,012. The value for 1905 represents 19,334,168 short tons, an average price per ton of 53 cents.

Limestone for building purposes increased in value $768,423, or from $4,543,760 in 1904 to $5,312,183 in 1905.

The States showing greatest value of limestone output are Pennsylvania, Illinois, Indiana, Ohio, Missouri, and New York in 1905, and in 1904 Pennsylvania, Indiana, Illinois, Ohio, Missouri, and New York, each State having a value of over $1,500,000.

The following tables show the value of the production of limestone in the United States in 1904 and 1905, by States and uses:

Value of the production of limestone in the United States in 1904 and 1905, by States and uses.

1904.

State.	Rough building.	Dressed building.	Flagging.	Curbing.	Paving.	Stone sold to lime burners.
Alabama		$34,341				$320
Arizona						
Arkansas	$6,615	46,765		$830		
California	2,400			125	$100	49,430
Colorado						18,692
Connecticut						
Florida	778	8,000				
Georgia						
Idaho						5,900
Illinois	212,477	53,804	$18,401	17,084	4,985	7,575
Indiana	1,116,928	942,458	30,085	105,151	9,658	
Indian Territory						
Iowa	149,215	18,259	3,556	5,414	3,181	15
Kansas	109,152	48,932	8,337	24,706	726	
Kentucky	68,826	65,955	1,718	24,980	1,500	
Maine						
Maryland	12,836		80	241	715	2,466
Massachusetts	2,375					
Michigan	32,941	805			37,665	180,683
Minnesota	108,798	102,819	11,104	6,296	6,018	4,800
Missouri	139,502	271,416	7,712	8,477	2,400	50
Montana	3,045					
Nebraska	30,969	1,592	165	261	12	9,578
New Jersey	3,025	150				6
New Mexico						
New York	174,099	42,803	4,708	7,221	11,147	271,105
North Carolina						
Ohio	272,941	9,291	4,669	3,563	4,186	448
Oklahoma	12,359	6,210	5,550	1,392		
Oregon	2,000	740		150		
Pennsylvania	146,868	4,311	4,129	6,773	82,502	22,613
Rhode Island						
South Carolina						
South Dakota	926					
Tennessee	19,039	10,410	400	4,997	1,000	
Texas	40,435	21,430	1,677	5,994		
Utah	4,897	300				17,370
Vermont	5,000					
Virginia	8,800	360				
Washington	125				1,486	4,906
West Virginia	10					13,592
Wisconsin	156,687	5,878	5,738	56,591	19,389	200
Wyoming	2,660					3,900
Total	2,846,728	1,697,032	108,029	280,246	186,670	613,649

Value of the production of limestone in the United States in 1904 and 1905, by States and uses—Continued.

1904.

State.	Crushed stone.			Rubble.	Riprap.	Flux.	Other.	Total.
	Road making.	Railroad ballast.	Concrete.					
Alabama	$7,915	$908	$8,533		$85,200	$361,503		$498,723
Arizona							$250	250
Arkansas	33,750	3,100	2,200	$12,012	800		75	106,147
California	5,650	3,100	5,325			140	8,400	74,670
Colorado					3,150	102,758		124,600
Connecticut						830		830
Florida	300			200	25,000			34,278
Georgia		11,200	4,000					15,200
Idaho								5,900
Illinois	641,387	297,863	627,942	357,517	124,541	324,998	2,248	2,690,822
Indiana	254,258	77,923	51,002	40,195	15,347	128,556	17,939	2,789,500
Indian Territory		2,242	3,834					6,076
Iowa	53,082	5,549	76,790	79,485	43,394		4,645	442,585
Kansas	45,949	418,438	56,735	52,486	32,756		1,069	799,286
Kentucky	186,796	280,489	30,959	9,690	8,494	9,420	3,590	692,417
Maine							2,955	2,955
Maryland	31,144	34,837	45,166	265		34	637	128,421
Massachusetts						5,191		7,566
Michigan	58,655	57,100	60,745	2,800	2,405	62,586	5,323	501,708
Minnesota	43,036	11,550	92,910	92,830	29,424	100	8,255	517,940
Missouri	471,254	437,334	460,767	255,308	178,756	9,460	35,533	2,277,969
Montana				250		106,470		109,765
Nebraska	16,065	34,273	61,873	47,512	26,297	5,150	3,033	236,780
New Jersey	2,984			1,200		65,922	3,423	76,710
New Mexico								
New York	418,661	257,231	272,471	20,755	9,461	130,251	16,342	1,636,255
North Carolina	12,088							12,088
Ohio	765,603	361,850	217,961	21,311	97,794	588,579	58,159	2,406,355
Oklahoma	20	60,000		4,765	800		1,150	92,246
Oregon				2,500				5,390
Pennsylvania	344,953	555,839	381,200	4,301	4,174	2,058,018	93,069	3,708,750
Rhode Island						312		312
South Carolina	125					100		225
South Dakota			2,400		600	28		3,954
Tennessee	60,736	68,944	17,324	13,336	6,687	82,573	2,607	288,053
Texas	15,418	19,060	8,171	7,624	66,930	64,072	1,934	252,745
Utah	5,995	6,000	1,200	900		133,685	100	170,447
Vermont	931		3,300	9		413		9,653
Virginia	210	32,371	5,668	168		117,882		165,459
Washington		150				65,085	105	71,857
West Virginia	42,965	98,105	61,096			244,535		460,303
Wisconsin	195,057	17,546	129,965	41,039	30,084	30,867	49,643	738,684
Wyoming			1,100		180	3,250	4,000	15,090
Total	3,714,987	3,153,002	2,690,637	1,068,458	792,274	4,702,768	324,484	22,178,964

Value of the production of limestone in the United States in 1904 and 1905, by States and uses—Continued.

1905.

State.	Rough building.	Dressed building.	Flagging.	Curbing.	Paving.	Stone sold to lime burners.
Alabama	$100	$35,000				
Arizona	135					
Arkansas	22,710	63,971	$731	$946	$300	
California	1,000					$36,685
Colorado						24,427
Connecticut						
Florida		5,000				
Georgia						100
Idaho	105					14,000
Illinois	123,140	73,246	16,204	10,373	53,410	15,585
Indiana	1,155,728	1,337,232	29,699	134,898	5,421	193
Indian Territory						
Iowa	137,805	35,387	12,337	3,366	7,576	
Kansas	98,571	41,525	5,095	9,196	13,338	50
Kentucky	91,987	80,098	1,917	25,112	3,675	247
Maine						
Maryland	42,691	75	131	15	100	699
Massachusetts	58,175	3,000				
Michigan	17,071			160		9,380
Minnesota	161,292	102,464	14,524	6,939	544	34
Missouri	319,822	269,013	12,244	12,704	6,546	
Montana	4,066		150			
Nebraska	19,957	100	16	42	65	12,149
New Jersey	845	30				14
New Mexico	600					
New York	183,833	80,692	15,792	29,660	500	163,475
North Carolina						
Ohio	218,364	13,107	3,972	2,390	5,474	51,433
Oklahoma	17,194	2,540	3,260	415	175	
Oregon	3,000	800				
Pennsylvania	158,875	1,485	5,689	24,367	110,208	36,865
Rhode Island						
South Carolina						
South Dakota	448					
Tennessee	37,653	14,400	400	4,652	250	
Texas	36,840	7,438	747	1,825		
Utah	8,960					18,785
Vermont	205					
Virginia	5,390	700				
Washington	3,400					5,322
West Virginia	71					6,830
Wisconsin	183,263	30,434	4,893	16,326	24,203	2,675
Wyoming	1,150			40		9,600
Total	3,114,446	2,197,737	127,801	283,426	231,785	408,548

Value of the production of limestone in the United States in 1904 and 1905, by States and uses—Continued.

1905.

State.	Crushed stone.			Rubble.	Riprap.	Flux.	Other.	Total.
	Road making.	Railroad ballast.	Concrete.					
Alabama	$3,725		$7,275		$89,063	$395,935	$1,005	$532,103
Arizona								135
Arkansas	14,600	$2,012	9,500	$39,850	198			154,818
California	3,000	510	2,700			3,677	2,3[illegible]0	49,902
Colorado						265,493		289,920
Connecticut						1,558		1,558
Florida			300	500				5,800
Georgia		5,000	1,000	960	100	1,270	600	9,030
Idaho								14,105
Illinois	793,401	655,276	594,293	388,845	35,000	582,873	170,244	3,511,890
Indiana	222,441	84,007	30,364	33,438	9,984	117,790	28,064	3,189,259
Indian Territory		3,624	1,888					5,512
Iowa	65,543	14,262	81,974	48,341	39,004		6,196	451,791
Kansas	28,913	618,189	25,365	37,500	13,645	2,000	30,002	923,389
Kentucky	202,532	250,115	65,427	6,022	5,340	7,733	4,260	744,465
Maine							7,428	7,428
Maryland	31,823	35,210	32,608		500		4,550	149,402
Massachusetts						4,733		65,908
Michigan	112,113	43,649	107,396	744	1,568	109,883	142,790	541,754
Minnesota	47,139	11,700	98,379	75,845	29,885		6,656	555,401
Missouri	376,349	381,018	488,252	190,934	153,512	16,624	11,146	2,238,164
Montana						98,907		103,123
Nebraska	24,050	29,442	79,311	22,447	21,496	16,000	44	225,119
New Jersey	1,750		10,825			133,889		147,353
New Mexico				600	6,000			7,200
New York	451,115	344,976	352,627	21,538	14,679	300,441	11,640	1,970,968
North Carolina	16,500							16,500
Ohio	790,138	461,235	248,578	22,487	68,094	872,353	93,168	2,850,793
Oklahoma	22,675	90,000	21,185	4,068	200		1,700	163,412
Oregon	4,500				300			8,600
Pennsylvania	255,471	597,940	322,218	7,265	16,487	2,842,202	120,431	4,499,503
Rhode Island						300		300
South Carolina								
South Dakota			6,205					6,653
Tennessee	39,127	81,693	48,930	1,868	6,895	165,754		401,622
Texas	7,000	14,500	14,143	9,533	20,649	57,599	1,573	171,847
Utah	890		150			203,644	90	232,519
Vermont	350		6,000	2,700		1,794	46	11,095
Virginia	5,254	9,333	11,187		120	180,676		212,660
Washington						43,450	298	52,470
West Virginia	32,559	81,550	32,300		200	516,250	1,558	671,318
Wisconsin	284,083	7,870	123,406	28,482	40,262	53,337	4,847	804,081
Wyoming		2,700		1,750		8,100		23,340
Total	3,837,041	3,826,811	2,823,786	945,717	573,181	7,004,265	650,666	26,025,210

The following table shows the value of limestone, by States, from 1901 to 1905, inclusive:

Value of limestone, 1901–1905, by States.

State.	1901.	1902.	1903.	1904.	1905.
Alabama	$417,837	$524,049	$502,510	$498,723	$532,103
Arizona	....	....	....	250	135
Arkansas	6,156	30,310	153,291	106,147	154,818
California	301,830	100,848	229,376	74,670	49,902
Colorado	143,333	157,355	175,078	124,600	289,920
Connecticut	1,050	1,472	1,968	830	1,558
Florida	12,720	25,608	20,756	34,278	5,800
Georgia	19,741	39,865	10,450	15,200	9,030
Idaho	645	2,025	752	5,900	14,105
Illinois	2,289,819	2,736,964	2,726,470	2,690,822	3,511,890
Indiana	2,769,846	2,553,502	2,621,068	2,789,500	3,189,259
Indian Territory	....	....	650	6,076	5,512
Iowa	555,724	535,933	536,906	442,585	451,791
Kansas	472,636	663,178	480,609	799,286	923,389
Kentucky	187,277	577,854	695,602	692,417	744,465
Maine	6,021	3,000	1,863	2,955	7,428
Maryland	74,724	126,613	65,732	128,421	149,402
Massachusetts	9,778	14,869	9,656	7,566	65,908
Michigan	429,771	413,148	390,473	501,708	544,754
Minnesota	465,501	754,987	609,471	517,940	555,401
Missouri	815,723	1,181,359	1,874,740	2,277,969	2,238,164
Montana	121,616	95,950	131,594	109,765	103,123
Nebraska	154,217	145,323	187,718	236,780	225,119
New Jersey	247,031	58,172	66,915	76,710	147,353
New Mexico	....	....	....	....	7,200
New York	1,107,358	1,857,893	2,007,911	1,636,255	1,970,968
North Carolina	4,668	21,063	....	12,088	16,500
Ohio	1,879,619	2,119,441	2,349,661	2,406,355	2,850,793
Oklahoma	32,497	50,516	50,690	92,246	163,412
Oregon	12,100	....	3,000	5,390	8,600
Pennsylvania	3,831,391	3,990,644	4,343,643	3,708,750	4,499,503
Rhode Island	232	1,190	883	312	300
South Carolina	1,000	350	950	225	....
South Dakota	39,950	65,305	26,215	3,954	6,653
Tennessee	149,708	246,418	356,961	288,053	401,622
Texas	116,071	146,162	188,015	252,745	171,847
Utah	41,990	87,200	125,610	170,447	232,519
Vermont	738	6,397	9,955	9,653	11,095
Virginia	319,115	292,129	232,744	165,459	212,660
Washington	24,246	27,744	75,649	71,857	52,470
West Virginia	436,252	434,758	405,077	460,303	671,318
Wisconsin	702,787	801,701	701,347	738,684	804,081
Wyoming	125	4,090	150	15,090	23,340
Total	18,202,843	20,895,385	22,372,109	22,178,964	26,025,210

The following table shows the quantity and value of blast-furnace flux produced in 1904 and 1905, by States:

Production of blast-furnace flux in 1904 and 1905, by States.

[Long tons.]

State.	1904.		1905.	
	Quantity.	Value.	Quantity.	Value.
Alabama	759,331	$361,503	764,173	$395,935
California	140	140	3,677	3,677
Colorado	215,101	102,758	544,984	265,493
Connecticut	2,305	830	4,236	1,558
Georgia			2,850	1,270
Illinois	686,958	324,998	1,576,081	582,873
Indiana	298,913	128,556	243,822	117,790
Kansas			4,000	2,000
Kentucky	18,070	9,420	20,497	7,733
Maryland	78	34		
Massachusetts	13,678	5,191	11,722	4,733
Michigan	136,293	62,586	294,895	109,883
Minnesota	200	100		
Missouri	16,860	9,460	29,922	16,624
Montana	250,700	106,470	238,563	98,907
Nebraska	10,300	5,150	20,000	16,000
New Jersey	130,071	65,922	265,042	133,889
New York	230,839	130,251	574,047	300,441
Ohio	1,479,350	588,579	2,163,554	872,353
Pennsylvania	4,727,632	2,058,018	6,325,503	2,842,202
Rhode Island	279	312	200	300
South Carolina	350	100		
South Dakota	56	28		
Tennessee	173,740	82,573	340,342	165,754
Texas	133,651	64,072	88,274	57,599
Utah	197,647	133,685	260,016	203,644
Vermont	413	413	3,589	1,794
Virginia	273,826	117,882	393,662	180,676
Washington	117,041	65,085	65,500	43,450
West Virginia	711,883	244,535	1,028,622	516,250
Wisconsin	66,333	30,867	106,640	53,337
Wyoming	5,000	3,250	13,478	8,100
Total	10,657,038	4,702,768	15,387,891	7,004,265

From this table it will be seen that there was a large increase both in the quantity and value of stone used for furnace flux in 1905 as compared with 1904. The increase was from 10,657,038 long tons, valued at $4,702,768 in 1904, to 15,387,891 long tons, valued at $7,004,265 in 1905, an increase of 4,730,853 tons in quantity and of $2,301,497 in value.

In 1904, owing to the closing of a large number of iron furnaces, there was a decrease of 1,372,681 long tons, valued at $720,964, the figures for 1903 being 12,029,719 long tons, valued at $5,423,732. Resumption of the iron furnaces accounted for the large increase in quantity and value.

LIMESTONE PRODUCTION IN INDIVIDUAL STATES.

ALABAMA.

There was but little change in the Alabama limestone figures for 1905 as compared with 1904, except a small increase in the value of flux. The total value was $532,103 in 1905 and $498,723 in 1904. A large quantity of the riprap was used in the construction of jetties in the Mississippi River.

ARIZONA.

The greater part of the limestone quarried in Arizona is burned into lime, no account of which is taken in this report.

ARKANSAS.

An increased output of building stone and rubble caused the increase in value of output from $106,147 in 1904 to $154,818 in 1905, a gain of $48,671.

CALIFORNIA.

The greater part of the limestone of California is burned into lime. Some is sold to sugar refiners and ultimately burned into lime for use in bleaching the sugar. The total output was $49,902 in 1905 and $74,670 in 1904.

COLORADO.

The limestone quarried in Colorado is used almost entirely for lime burning and furnace flux, much of the lime going to the beet-sugar refineries. The quantity and value of flux quarried in 1905 was more than double that of the year 1904. The total output for 1905 was $289,920 and for 1904 $124,600, an increase of $165,320.

CONNECTICUT.

All of the Connecticut output of limestone, except a very limited quantity for furnace flux, is used in the manufacture of lime and is not included in this report.

FLORIDA.

Beside the stone burned into lime, a very small quantity is used for building stone. The total output was valued at $5,800 in 1905, as compared with $34,278 in 1904.

GEORGIA.

Beside the small quantity of limestone used as crushed stone in Georgia, a considerable quantity was quarried and burned into lime and also used for manufacture into Portland cement.

IDAHO.

The entire limestone output of Idaho went into the manufacture of lime, some of which was used by sugar manufacturers.

ILLINOIS.

Illinois in 1905 ranked second in value of limestone, being next to Pennsylvania and closely followed by Indiana. In 1904, Illinois was third in value of output, the output from Indiana being slightly greater.

The total value of the Illinois output, not including the lime burned, was $3,511,890 in 1905 and $2,690,822 in 1904, an increase of $821,068. The greater part of the stone in this State is crushed and used for concrete paving, road making, railroad ballast, etc. It is sometimes difficult to separate the values of the stone used for the different purposes, but the closest estimates possible have been made. The total value of limestone crushed for the various purposes was, in 1905, $2,042,970, and in 1904 $1,567,192, a gain of $475,778 for 1905. The quantity of crushed stone quarried in Illinois in 1905 was 3,556,054 short tons, having an average value of 57 cents per ton.

The stone quarried and sold for blast furnace flux was 1,576,081 long tons, valued at $582,873, in 1905, and 686,958 long tons, valued at $324,998, in 1904, a gain of 889,123 long tons in quantity and of $257,875 in value.

In addition, there was a considerable quantity of lime burned from the stone in this State.

INDIANA.

The output of Indiana limestone in 1905, not including the lime burned, was valued at $3,189,259, and at $2,789,500 in 1904, an increase of $397,759. The principal increase was in value of building stone, the chief purpose for which the stone of this State is used.

The building stone was valued at $2,492,960 in 1905, and at $2,059,386 in 1904, an increase of $433,574. The greater part of this stone is from the well-known district near Bedford, Lawrence County, and Bloomington, Monroe County. In 1905 the total for both counties was $2,393,475, of which $1,550,076 was from Lawrence County and $843,399 from Monroe County. In 1904 the total for the two counties was $1,643,974, Lawrence County furnishing $1,054,302 and Monroe County $589,672. This shows a total increase of $749,501, of which $495,774 was from Lawrence County and $253,727 from Monroe County. Besides building, this "Bedford stone" is used for flagstone, curbstone, monumental stone, a small quantity for crushed stone, and some for cement and lime, not included in the figures for the State.

In 1904, Indiana ranked second in the output of limestone, being closely followed by Illinois, but in 1905 Illinois with a large increase in crushed-stone production outranked Indiana and took second place.

INDIAN TERRITORY.

The Indian Territory limestone is not, as yet, at all well developed, some of the stone being burned into lime and the rest used for crushed stone.

IOWA.

The limestone output was valued at $442,585 in 1904 and at $451,791 in 1905, a gain of $9,206. There was also considerable limestone burned into lime and used in the manufacture of Portland cement.

KANSAS.

Exclusive of the value of limestone burned into lime and used in the manufacture of Portland cement, the output of Kansas was valued at $799,286 in 1904 and at $923,389 in 1905, a gain of $124,103. The principal increase was in the value of crushed stone output.

KENTUCKY.

Increased use of stone for building and crushed stone raised the value of the limestone output of Kentucky from $692,417 in 1904 to $744,465 in 1905, a gain of $52,048. Lime was also burned from the stone in this State.

MAINE.

Almost the total output of Maine limestone is burned into lime. A description of the Maine limestone region has been given by Mr. E. F. Bastin in a recent report to the United States Geological Survey.[a]

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[a] Bull. U. S. Geol. Survey No. 285, 1906, pp. 393-400.

MARYLAND.

The chief use of the Maryland limestone is for lime burning. The value otherwise reported was $149,402 in 1905 and $128,421 in 1904, an increase of $20,981.

MASSACHUSETTS.

Besides the small quantity of limestone used for building and flux, the limestone quarried in Massachusetts is burned into lime.

MICHIGAN.

Michigan reported an output of limestone valued at $544,754 in 1905, as compared with $501,708 in 1904, an increase of $43,046. Crushed stone, lime, stone for blast-furnace flux, chemical works, and beet-sugar refineries are the chief uses of this stone.

MINNESOTA.

Minnesota increased in value of limestone output $37,461 in 1905, as compared with 1904—from $517,940 in 1904 to $555,401 in 1905. Building, crushed stone, and rubble are the purposes for which the greater part of the stone is quarried.

MISSOURI.

Missouri ranks fifth in the list of limestone-producing States, being exceeded by Pennsylvania, Illinois, Indiana, and Ohio.

The total value for 1905 was $2,238,164 and for 1904 $2,277,969, a decrease of $39,805. The decrease was in the value of crushed stone, which was valued at $1,245,619 in 1905, as compared with $1,369,355 in 1904, a decrease of $123,736. The tonnage represented by the 1905 figures was 2,076,880 short tons, an average value of about 60 cents per ton. The building stone output increased from $410,918 in 1904 to $588,835 in 1905, a gain of $177,917.

A large quantity of lime is also burned in this State.

MONTANA.

The value of the output of limestone, excluding lime, from Montana in 1905 was reported at $103,123; in 1904 the value reported was $109,765, a decrease of $6,642.

NEBRASKA.

There was a decrease of $11,661 in the output of limestone quarried in Nebraska from $236,780 in 1904 to $225,119 in 1905. The output is chiefly for crushed stone.

NEW JERSEY.

The limestone from this State is used for blast-furnace flux, the manufacture of Portland cement, and burning into lime, with a small quantity for other purposes.

The total value of the output, not including the lime or stone used for cement making, was valued at $76,710 in 1904 and $147,353 in 1905, an inrcease of $70,643. The increase was in the value of furnace flux.

NEW MEXICO.

The small quantity of limestone quarried in this State and not burned into lime was valued at $7,200 in 1905 and was chiefly used for riprap work.

NEW YORK.

New York ranks sixth in the list of limestone-producing States, the value of output for 1905 being $1,970,968, as compared with $1,636,255 in 1904, an increase of

$334,713. There was a large increase in the quantity and value of flux quarried from 230,839 long tons, valued at $130,251, in 1904 to 574,047 long tons, valued at $300,441, in 1905, an increase of 343,208 tons in quantity and of $170,190 in value. The crushed stone increased in value from $948,363 in 1904 to $1,148,718 in 1905, or $200,355. The other increase was in building stone. Considerable stone in this State is used for chemical purposes, and not included in the total is a large quantity of lime and of stone for the manufacture of cement.

NORTH CAROLINA.

Crushed stone valued at $16,500 was reported from this State in 1905. Besides this some lime is burned.

OHIO.

Ohio is the fourth State in rank of limestone production, being exceeded by Pennsylvania, Illinois, and Indiana. In previous years, when the value of lime has been included, Ohio ranked next to Pennsylvania.

The total value, not including lime, was $2,850,793 in 1905 and $2,406,355 in 1904, a gain of $444,438. The greater part of the gain was in quantity and value of flux quarried, which increased from 1,479,350 long tons, valued at $588,579, in 1904 to 2,163,554 long tons, valued at $872,353, in 1905, an increase of 684,204 tons in quantity and of $283,774 in value.

The crushed stone was valued at $1,345,414 in 1904 and at $1,499,951 in 1905, an increase of $154,537. The quantity of crushed stone represented by the 1905 figures was 3,000,207 short tons.

OKLAHOMA.

An increase in the output of crushed stone was the occasion of the increase of $71,166 in value of the limestone produced in Oklahoma in 1905 from $92,246 in 1904 to $163,412 in 1905. Besides this there was a small quantity of lime burned.

OREGON.

The value of the limestone reported from Oregon, exclusive of lime, was $8,600 in 1905, against $5,390 in 1904, an increase of $3,210.

PENNSYLVANIA.

Pennsylvania ranks first in the list of limestone-producing States. The value in 1905 was $4,499,503; in 1904, $3,708,750, a gain of $790,753. The large increase in total value is almost entirely due to the increased tonnage of limestone quarried for blast-furnace flux. These figures were 4,727,632 long tons, valued at $2,058,018, in 1904, and 6,325,503 long tons, valued at $2,842,202, in 1905, an increase of 1,597,871 tons in quantity and of $784,184 in value. Crushed limestone decreased from $1,281,992 in 1904 to $1,175,629 in 1905, or $106,363. The quantity of crushed stone quarried in 1905 was 2,159,121 short tons.

RHODE ISLAND.

The limestone in Rhode Island is almost entirely burned into line.

SOUTH CAROLINA.

No limestone other than that burned into lime was quarried in South Carolina in 1905.

SOUTH DAKOTA.

The value of the output of limestone from South Dakota reported in 1905 was $6,653, as compared with $3,954 reported in 1904, a gain of $2,699.

TENNESSEE.

The production of limestone in Tennessee in 1905 was valued at $401,622, as against $288,053 in 1904, an increase of $113,569. The increase was in the value of crushed stone, building stone, blast-furnace flux, and riprap. Considerable lime is also burned in this State.

TEXAS.

There was a decrease in the value of limestone quarried in Texas from $252,745 in 1904 to $171,847 in 1905, or $80,898. Limestone was also quarried and burned into lime.

UTAH.

The limestone reported as quarried in Utah in 1905 was valued at $232,519, against $170,447 in 1904, an increase of $62,072, the principal increase being in the quantity and value of furnace flux quarried. Lime was also burned from the stone in this State.

VERMONT.

The limestone quarried in Vermont was mostly burned into lime. The stone reported, exclusive of this lime, was $11,095 in 1905 and $9,653 in 1904, an increase of $1,442.

VIRGINIA.

The value of the output of limestone in Virginia in 1905 was $212,660, against $165,459 in 1904, an increase in 1905 of $47,201. The increase was in the value of blast-furnace flux.

WASHINGTON.

Besides the lime burned in this State, the limestone production is chiefly furnace flux. The total value, not including lime, in 1905 was $52,470; in 1904 it was $71,857, a decrease of $19,387.

WEST VIRGINIA.

The value of limestone reported from West Virginia in 1905 was $671,318, against $460,303 in 1904, an increase of $211,015, the increase being chiefly in blast-furnace flux. A considerable quantity of lime is burned in this State.

WISCONSIN.

There was an increase of $65,397 in the value of the limestone reported from Wisconsin in 1905, from $738,684 in 1904 to $804,081 in 1905. This does not include a large quantity of lime.

WYOMING.

The limestone quarried in Wyoming in 1905 was valued at $23,340, as compared with $15,090 in 1904, an increase of $8,250

ABRASIVE MATERIALS.

By Joseph Hyde Pratt.

INTRODUCTION.

The abrasive materials that are included in this report are as follows: Oilstones and scythestones, grindstones and pulpstones, buhrstones and millstones, flint pebbles, pumice, infusorial earth and tripoli, crystalline quartz and feldspar, garnet, corundum and emery, carborundum, crushed steel and artificial corundum. Of these materials, there is in some cases but a small part of the entire production that is actually used for abrasive purposes, and in the following report there is included, with the exception of infusorial earth and tripoli, only that portion of the production that is actually used for abrasive purposes. Thus, under grindstones and pulpstones, which are obtained from sandstone, only a small percentage of the stone that is quarried is used in the manufacture of these abrasives, the remainder being used for building purposes. This is also true of certain of the materials from which oilstones and scythestones are manufactured. In the case of buhrstones and millstones, the larger part of the material that is taken out from the quarries is simply used in the manufacture of these stones. All of the pumice is used for abrasive purposes in one form or another. Of the crystalline quartz that is mined in the United States, only a very small part is used for abrasive purposes, and this is also true of feldspar. All of the garnet that is mined, except that which is of value as gems, is used as an abrasive material, and this is also true of corundum and emery.

Descriptions of the different abrasives have appeared in preceding reports of this Bureau. Thus, oilstones and whetstones were described fully in the report for 1901; and grindstones, buhrstones, millstones, and infusorial earth and tripoli in the reports for 1900 and 1901. Deposits of infusorial earth, in Pinal County, Ariz., were described by Mr. W. P. Blake[a] in 1902. Pumice was treated in this report for 1901, and artificial abrasives in the same report. In the report for 1903 an article on carborundum by Mr. F. A. J. Fitzgerald was quoted from the Iron Age,[b] and also an abstract on crushed steel, from the Proceedings of the American Association for the Advancement of Science.[c]

More or less brief descriptions of the natural abrasives will be found in The Non-Metallic Minerals, by Mr. George P. Merrill.[d] Corundum has been treated in the first volume of the North Carolina Geological Survey, and also in Bulletin No. 269 of the United States Geological Survey.[e]

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[a] Am. Inst. Min. Eng., February meeting, 1902.

[b] Iron Age, October 15, 1903.

[c] Proc. Am. Assn. Adv. Sci., Pittsburg meeting, 1903.

[d] Merrill, George P., The Non-Metallic Minerals, 1901.

[e] Ann. Rept. North Carolina Geol. Surv., Vol. 1, 1905; Bull. U. S. Geol. Survey No. 269, 1905.

The most noticeable changes in regard to the production of abrasive material in the United States during 1905 were the large falling off in the value of the production of grindstones and pulpstones and of artificial abrasives as compared with the corresponding values of 1904, and the decided increase in all of the other natural abrasive materials, with the exception of crystalline quartz.

The aggregate value of the production of the natural abrasive materials during 1905 was $1,427,980, which is an increase of $20,879, as compared with $1,407,101, the value of the 1904 production. There are given in the following table the values of the different abrasive materials produced in the United States from 1901 to 1905, inclusive:

Value of abrasives produced in the United States, 1901–1905.

Kind of abrasive.	1901.	1902.	1903.	1904.	1905.
Oilstones and scythestones	$158,300	$221,762	$366,857	$188,985	$244,346
Grindstones and pulpstones	580,703	667,431	721,446	881,527	777,606
Buhrstones and millstones	57,179	59,808	52,552	37,338	37,974
Pumice		2,750	2,665	5,421	5,540
Infusorial earth and tripoli	52,950	53,244	76,273	44,164	64,637
Crystalline quartz	41,500	84,335	76,908	[a] 74,850	[a] 88,118
Garnet	158,100	132,820	132,500	117,581	148,095
Corundum and emery	146,040	104,605	64,102	57,235	61,464
Total	1,194,772	1,326,755	1,493,303	1,407,101	1,427,980

[a] Including feldspar.

As is seen in this table, there is considerable variation from year to year in the value of the different abrasive materials, and this represents in nearly all cases a corresponding variation in the quantity produced. The greatest gain during 1905 was in the value of the production of oilstones and scythestones, and there were also decided gains in value of the outputs of garnet, infusorial earth and tripoli, and crystalline quartz and feldspar. There was but a slight gain in pumice and buhrstones and millstones, and a more decided increase in corundum and emery. It often happens that in one year there will be a larger quantity of certain of the abrasive materials produced than is required, and thus a certain portion of this material is held over until the following year, and the actual production of that year is curtailed accordingly. As a rule, however, the actual quantity of abrasive materials produced and put on the market in one year, including the natural and artificial abrasives produced in this country and those imported, is gradually increasing in quantity.

The value of the artificial abrasive materials manufactured during 1905 is estimated at $701,400 as compared with the estimated value of $830,926 of the 1904 production, a decrease of $129,526. This, however, is a large increase as compared with $493,815 in 1903, and with $390,245 in 1902. It will be noticed that in 1904 there was an increase of nearly 70 per cent in the value of the artificial abrasives as compared with 1903, and this exceptionally large increase in that year will account somewhat for the decrease in 1905. The quantity of the 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, 1901–1905.

[Pounds.]

Kind of abrasive.	1901.	1902.	1903.	1904.	1905.
Carborundum	3,838,175	3,741,500	4,759,890	7,060,380	5,596,000
Crushed steel	690,000	735,000	755,000	790,000	612,000
Alundum (artificial corundum)				4,020,000	3,612,000

The total estimated value of all abrasive materials consumed in the United States for the years 1900 to 1905, inclusive, are given in the table following:

Total value of all abrasive materials consumed in the United States, 1900–1905.

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	1,407,101	830,926	547,804	2,785,831
1905	1,427,980	701,400	654,821	2,784,201

There is a certain quantify of abrasive materials exported each year from the United States, and the total values given above should probably be reduced by $75,000 to $100,000 for each year.

There were 23 different States which contributed to the 1905 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 1905.

1. Ohio: Grindstones, pulpstones, oilstones, and scythestones.
2. New York: Millstones, infusorial earth, crystalline quartz, garnet, and emery.
3. Michigan: Grindstones and scythestones.
4. Arkansas: Oilstones.
5. Pennsylvania: Millstones, crystalline quartz, and garnet.
6. Missouri: Grindstones and infusorial earth.
7. New Hampshire: Scythestones.
8. Connecticut: Infusorial earth and crystalline quartz.
9. Minnesota: Feldspar.
10. Vermont: Scythestones.
11. West Virginia: Grindstones.
12. Indiana: Scythestones.
13. Massachusetts: Infusorial earth and emery.
14. North Carolina: Millstones, garnet, and corundum.
15. Virginia: Millstones.
16. Wisconsin: Crystalline quartz.
17. Nebraska: Pumice.
18. California: Infusorial earth.
19. Montana: Grindstones and corundum.
20. Georgia: Infusorial earth.
21. South Dakota: Pumice.
22. Wyoming: Grindstones.
23. Idaho: Pumice.

In 1904 there were 26 States that contributed to the production of abrasive materials, of which Florida, Kansas, Kentucky, and Maryland did not report any output during 1905. Idaho, however, was a new State added to the list.

BUHRSTONES AND MILLSTONES.

The American stone used in the manufacture of buhrstones and millstones varies from a sandstone to a quartz conglomerate rock which occurs along the eastern slopes of the Appalachian Mountains from New York to North Carolina. It is known locally by different names as Esopus stone from Ulster County, N. Y.; Cocalico stone from Lancaster County, Pa.; Brush Mountain stone from Montgomery County, Va.; and Carolina stone from Rowan County, N. C. The buhrstones imported from France, Belgium, and Germany are decidedly different in character, and they are usually brought into this country in pieces and then made up into buhrstones.

PRODUCTION.

The production of buhrstones and millstones in the United States during 1905 was valued at $37,974, a very slight increase over $37,338, the value in 1904. The production of 1905 is only about one-third of what it was in 1887, at the time of the introduction of the roller-mill process for grinding wheat flour. The demand for these stones for use in grinding mineral paints, barytes, drugs, paste, mustard, cement, plaster, fertilizers, glucose, chocolate, spices, etc., is not very large, although wherever such stones have been used they have for the most part given satisfaction. There are a number of States in which rock of the right texture and quality for manufacturing into buhrstones can be obtained, but there were only four States reporting a production of buhrstones or millstones in 1905, with a total of 25 producers, as follows: New York, 14; Pennsylvania, 5; Virginia, 4; North Carolina, 2.

There is given in the following table the values of the productions for the years 1902 to 1905, inclusive, by States.

Value of buhrstones produced in the United States, 1902–1905, by States.

State.	1902.	1903.	1904.	1905.
New York	$39,570	$35,441	$24,585	$25,915
Virginia	11,435	9,812	4,759	8,186
North Carolina and Vermont	6,825	5,902	[a] 6,500	[a] 2,522
Pennsylvania	1,978	1,397	1,494	1,351
Total	59,808	52,552	37,338	37,974

[a] No production of buhrstones from Vermont in 1904 and 1905.

The following table gives the value of buhrstones produced in the United States since 1880:

Value of buhrstones produced in the United States, 1880–1905.

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	1905	37,974

IMPORTS.

The value of the imports of buhrstones into the United States varies considerably from year to year. The following table gives the imports for the last five years:

Value of buhrstones and millstones imported into the United States, 1901–1905.

Year.	Rough.	Made into millstones.	Total.	Year.	Rough.	Made into millstones.	Total.
1901	$40,885	$1,302	$42,187	1904	$30,117	$2,269	$32,386
1902	15,243	915	16,158	1905	30,478	938	31,416
1903	21,160	8,481	29,641				

FLINT PEBBLES.[a]

The flint pebbles of greatest economic value are recovered from the enormous beds of Cretaceous chalk on the seacoasts of Greenland and France. These pebbles—a chalcedonic variety of silica—are irregular in shape and size, some being as large as a goose egg, vary in color from gray to brown and black, and are extremely hard.

In America, particularly in Texas, black flint pebbles occur in quantity on the banks of the Colorado River. Some pebbles are also found in Florida, California, and Kansas. In Colorado and other mountainous States there occur numerous white, light gray, or drab flints or cherts which may some day be utilized.

Since the introduction of the tube mill for fine grinding of mineral substances there has been a rapid growth in the demand for flint pebbles.

Producing countries.—The producing area in Europe is situated along the coast of Greenland and on the beaches between Havre and St. Valery-sur-Somme, France. It is estimated that the French deposits cover a distance of something over 100 miles and yield annually for export, principally to the United States, Australia, and the Transvaal, from 13,500 to 14,000 metric tons.

The method of producing flint pebbles is rather primitive, and a fact worthy of comment is that notwithstanding the numerous concessionaries working the deposits the industry is controlled by a few of the larger export firms. The custom of the Danish and the French governments is to lease the pebble-bearing deposits periodically to the highest bidders for a term of years. The concessionaries pay a stipulated fee in addition to a royalty based on a minimum annual output fixed by the government. The successful bidders include Americans and other foreigners whose customers are numerically large enough to guarantee a steady production and a fair profit in trading. In France a concession is granted for a term of nine years. During this period it sometimes happens that the yield of good-sized pebbles is so variable as to make the concession an unprofitable speculation.

Flint pebbles are recovered by hand picking, usually during the winter months after the peasants who are employed in this industry have harvested their crops and have ceased work on their farms. Women and children generally pick the pebbles. The pickers are shrewd workers, and in filling the baskets which they carry on their backs they seldom discriminate between the good and the bad pebbles so long as they can gather a big load. When their baskets are full the pickers receive a tally or credit check, and at the end of the day's work are paid off accordingly. The baskets are emptied into a cart hitched to a donkey, and when the vehicle has been filled it is drawn to the storehouse. Here other women separate the pebbles from the pieces of chalk and finally arrange the pebbles by size to be bagged for shipment. French pebbles are

[a] By Charles C. Schnatterbeck.

exported from Dieppe and Havre in bags containing 130 pounds; the Greenland product, known in the market as Danish pebbles, is shipped from Copenhagen, Denmark, in casks of 160 kilos (352 pounds).

Consumption.—In recent years there has been a marked increase in the consumption of flint pebbles, due principally to the expansion in the use of the tube mill for fine grinding of cement and gold ores. The tube mill is a horizontal steel cylinder from 60 to 125 feet long, the standard tube of 100 feet in length having a diameter at the large end of 7½ feet and at the small end of 6½ feet. The mill is lined with silex or flint blocks which are roughly hewn and a little larger than an ordinary building brick. Portland cement is used to fill the crevices of the flint-block lining. These flint bricks are produced in Sweden and Belgium principally, and are exported to all parts of the world.

The flint pebbles used in the tube mill fill one-third of the machine, the quantity being usually from 5 to 6 tons. The mill in revolving rolls the pebbles, which furnish the power of attrition. It is estimated that about one pound of pebbles is consumed per ton of cement or gold ore treated. The pebbles most in favor for this purpose are medium in size—that is, from 2 to 3⅛ inches in largest diameter. As they wear round and become smaller, mill men will often change the size of the pebbles in order to improve the grinding process. It is claimed that symmetrical, spherical flint pebbles of medium size effect an economy of power, and that angular stones cause a rubbing action which prevents regular grinding and initiates a waste of power. It is suggested, however, that experiments be made to determine the size and shape of pebbles which are best suited for the tube mill. Incidentally some investigation might be made also of the size of mill which would show the most economy in operation under different loads and at a fluctuating speed.

Imports.—The imports of flint pebbles as ballast into the United States in 1905, amounting to between 7,000 and 8,000 long tons, free of duty, show a substantial increase as compared with 1904. It is generally believed that imports during 1906 will record a further increase, and that Mexico also will offer an opportunity to enlarge the consumption of flint pebbles, especially in the gold metallurgical industry.

The bulk of the American imports have come from France, the ocean freight being about 10 francs ($1.93) per ton. In addition to the flint pebbles there were received in 1905 about 15,000 tons of flint bowlders, which were consigned to pottery manufacturers in Trenton, N. J., and elsewhere. The imports of flint blocks for lining tube mills amount annually to about 350 or 400 tons.

Prices.—Importers in the United States, by reason of their control of supplies abroad and of the fact that the cost of production has remained practically stationary—only the ocean freight fluctuating—seldom change their contract prices. Consumers also usually extend their contracts year after year on the same terms. Of course conditions may arise, as in the current year, when the demand becomes active, and sellers, failing to adhere religiously to their "gentleman's agreement" made in 1904 to fix prices and divide the consuming territory, crossed the swords of competition. Usually, however, sellers are satisfied with a fair profit, and as the business is still rather small, it seems injudicious to compete too keenly. In 1905 Danish flint pebbles, which are recognized as the standard in the market by reason of their hardness, were quoted at $16 to $20 per long ton, free on board New York. These pebbles are sold in four sizes, namely, A being 1¼ to 1½ inches in largest diameter; B, 1½ to 2 inches; C, 2 to 3⅛ inches, and D, 3⅛ to 3¾ inches. French pebbles, usually marketed in three sizes—A, 2½ to 3½ inches in largest diameter; B, 2 to 3 inches, and C, 1½ to 2 inches—were quoted during the year at $9.50 to $12 per long ton, free on board New York. Potters bought flint bowlders at about $4 per long ton, delivered in Philadelphia, Pa., a price which left little profit to the seller after deducting the ballast freight of $2.25 per ton and other charges. Natural flint blocks have been sold in cases weighing 320 pounds net at $8.80 to $10 per case, free on board New York.

Uses.—Flint is calcined and ground by potters for the purpose of mixing with clay to give body to porcelain ware. The competition of flint in this industry is keenest with quartz. Pulverized flint stones also find use in the manufacture of glass. Within the last few years the demand for flint pebbles for attrition mills has grown enormously, notwithstanding the competition with steel balls and China balls, which are more expensive.

CORUNDUM AND EMERY.

Never in the history of the abrasive industry has the time been more opportune for the development of corundum properties than at present when there is a scarcity of emery ore. Many of the mills in the United States are finding it difficult to keep their mills supplied with emery. The Greek and Turkish deposits are not furnishing the grade of emery that is desired, nor the quantity, and this has also been true during the past year of the emery mines in this country. The increasing demand for this type of abrasive should give an impetus to the development of the domestic corundum deposits. The Canadian corundum deposits supply to some extent the demand for corundum, but there is still a large enough market to warrant the working of deposits in this country.

PRODUCTION.

During 1905 the production of corundum and emery in the United States amounted to 2,126 short tons, valued at $61,464, as compared with 1,916 short tons, valued at $56,985, in 1904, an increase of 210 tons in quantity and of $4,479 in value. The corundum mined was from North Carolina and Montana and the emery from New York and Massachusetts. The following table gives the total quantity and value of the corundum and emery produced in the United States since 1881:

Annual production of corundum and emery, 1881–1905.

[Short tons.]

Year.	Quantity.	Value.	Year	Quantity.	Value.
1881	500	$80,000	1894	1,495	$95,936
1882	500	80,000	1895	2,102	106,256
1883	550	100,000	1896	2,120	113,246
1884	600	108,000	1897	2,165	106,574
1885	600	108,000	1898	4,064	275,064
1886	645	116,190	1899	4,900	150,600
1887	600	108,000	1900	4,305	102,715
1888	589	91,620	1901	4,305	146,040
1889	2,245	105,567	1902	4,251	104,605
1890	1,970	89,395	1903	2,542	64,102
1891	2,247	90,230	1904	1,916	56,985
1892	1,771	181,300	1905	2,126	61,464
1893	1,713	142,325			

IMPORTS.

The importation of corundum and emery into the United States is still largely in excess of the home production, and in 1905 these imports were valued at $347,425 against $260,424, the value in 1904. The following table shows the quantity and value of emery and corundum imported into the United States in the last five years:

Emery and corundum imported into the United States, 1901–1905.

Year ending—	Grains.		Ore and rock.		Other manufactures.	Total value.
	Quantity.	Value.	Quantity.	Value.	Value.	
	Pounds.		*Long tons.*			
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	[a] 194,468	17,829	321,569
1904	2,281,193	109,772	7,054	[b] 138,931	11,721	260,424
1905	3,209,915	143,729	11,073	185,689	18,007	347,425

[a] Including emery rock valued at $5,488.
[b] Including emery rock valued at $7,338.

CANADIAN CORUNDUM.

In 1905 the production of Canadian corundum amounted to 1,644 short tons, valued at $149,153, as compared with 919 short tons, valued at $101,050, in 1904, an increase of 725 short tons in quantity and of $48,103 in value. The increase in value did not keep pace with the increase in tonnage, the lower rate being due to the lower price received for the corundum. The values given are the prices of the cleaned product ready for shipment at the mine. The selling price of Canadian corundum varies from 4¼ to 5½ cents per pound, and at this low price it is becoming a stronger and stronger competitor of emery. Approximately two-thirds of the Canadian production was shipped to the United States. In the following table are given the quantity and value of the production of Canadian corundum for the years 1901 to 1905, inclusive:

Production of Canadian corundum, 1901–1905.

[Short tons.]

Year.	Quantity.	Value.
1901	434	$47,740
1902	805	88,616
1903	916	92,940
1904	919	101,050
1905	1,644	149,153

This table shows clearly the growth of the corundum industry in Canada, and the exportation of such a large portion of this corundum to the United States indicates the demand in this country for a good corundum for abrasive purposes.

CRYSTALLINE QUARTZ AND FELDSPAR.

Only a very small part of the crystalline quartz or feldspar mined in the United States is used for abrasive purposes and included in this report. The crystalline quartz which is included in this report is used principally as a wood filler and in the manufacture of sandpaper and of scouring soaps, and is obtained principally from New York, Connecticut, Pennsylvania, and Wisconsin. The feldspar is used in making sandpaper and cloth and some special abrasive products for use in woodworking factories, and is obtained from Minnesota. There is a large quantity of quartz used in the stonecutting trade, especially by marble dealers, in cutting blocks of stone into slabs by means of gang saws, and it is also used in considerable quantity on the rubbing tables in the manufacture of oilstones and scythestones. There is, however, little or no record kept by those who use sand for this purpose of the quantity they use or its value, and thus there has been no attempt made in this report to include this quartz.

PRODUCTION.

The production of crystalline quartz and feldspar in the United States during 1905 amounted to 19,039 short tons, valued at $88,118. There was a considerable falling off in the production of quartz in 1905, as compared with that of 1904, but a large increase in the amount of feldspar. The 1905 production of crystalline quartz was obtained from the following States, given in the order of the importance of their production and with the number of producers in each: Connecticut, 3; Wisconsin, 1; Pennsylvania, 1; New York, 1. The feldspar was obtained entirely from Minnesota by 2 producers. In the following table is given the quantity and value of crystalline quartz produced in the United States from 1894 to 1903, inclusive, and of crystalline quartz and feldspar for the years 1904 and 1905:

Production of crystalline quartz, 1894–1905.

[Short tons.]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
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	[a] 31,940	[a] 74,850
1899	13,600	39,000	1905	[a] 19,039	[a] 88,118

[a] Includes feldspar used for abrasive purposes.

GARNET.

PRODUCTION.

During 1905 the production of abrasive garnet in the United States amounted to 5,050 short tons valued at $148,095, as compared with 3,854 short tons in 1904 valued at $117,581, an increase of 1,196 tons in quantity and of $30,514 in value. This is the largest quantity of garnet produced in any year since these statistics have been collected, but the value is exceeded by that of 1901, when 4,444 short tons were valued at $158,100. The average price of the 1905 production was $29.32 as against $30.51, the average price per ton of the 1904 production. This was obtained from New York with 2 producers—Pennsylvania

1, and North Carolina 1—given in the order of the importance of their production.

A new, though small source of supply has been added within the last two years. That is the garnet sand separated from the monazite concentrates by the German Monazite Company, of Oak Springs, N. C. These concentrates come chiefly from the placers of Cleveland and Rutherford counties, and sometimes contain as much as 20 per cent or more of garnet. A very clean separation is made on the Wetherill magnetic separator, the garnet being saved as a by-product.

A brief description of the sources of supply in New York for 1905 has been given by Mr. D. H. Newland, in the Engineering and Mining Journal.[a] The interesting features are the opening of a new quarry by the North River Garnet Company on Thirteenth Lake, Warren County. The deposit is in a hornblende feldspar rock, probably belonging to the anorthosite series. The old quarries of this company and those now operated by H. H. Barton & Sons, near Minerva and Gore Mountain, Essex County, are in amphibolite, which appears to be an altered sediment. Experimental work has been carried on by Mr. G. W. Smith, of Keeseville, on a deposit in northern Essex County. Except for a small admixture of pyroxene, it is stated that a face 30 to 40 feet high and almost solid garnet has been exposed in one place in this locality. Other workable deposits are reported in the eastern Adirondacks.

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, 1894–1905.

[Short tons.]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
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	1905	5,050	148,095

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.

GRINDSTONES AND PULPSTONES.

The production of grindstones and pulpstones in the United States is almost entirely from Ohio and Michigan, and it is particularly from the former State that the chief supply is obtained. There are also smaller quantities of grindstones produced in West Virginia, Montana, Missouri, and Wyoming. The grindstones produced in the three last-named States are used simply for local purposes, and the industry has not yet assumed any considerable importance in them. The most extensive grindstone district in the United States is in the northern part of Ohio, and is included in Lorain, Cuyahoga, and Summit counties, with Cleveland as a center. In the southern part of Ohio, in Washington and Athens counties, there is another grindstone district, and between these

[a] Eng. and Min. Jour., January 6, 1906.

two, in Stark and Harrison counties, nearer the center of the State, there is a third district. A fourth district has more recently been developed in the extreme eastern part of the State, in Jefferson and Trumbull counties. The stone from which the grindstones and pulpstones are manufactured is the sandstone that is found so extensively in the Lower Carboniferous series of Ohio. There is, however, considerable local variation in this sandstone as it has been encountered in the different quarries, and there are seven grits that are recognized as distinctive.

In Michigan the grindstone quarries are near Grindstone City, Huron County, and the sandstone from which they are manufactured belongs to the Lower Carboniferous, the same as that observed in Ohio. This is also true of the sandstone in Wood and Jackson counties in West Virginia, from which there are small amounts of grindstones produced each year. The Missouri grindstone locality is located 5 miles from Collins, St. Clair County. The Montana locality is located near Columbus, Yellowstone County, and the Wyoming locality is near Rawlins, Carbon County. There have also been a few grindstones produced in South Dakota, near Edgemont, Fall River County, but for the last few years no work has been done at these quarries for grindstones.

PRODUCTION.

The production of grindstones and pulpstones during 1905 was obtained from Ohio, Michigan, West Virginia, Montana, Missouri, and Wyoming, given in the order of the value of their production. 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 1905 was $777,606, which was $103,921 less than the value, $881,527, of the 1904 production. Of the total value of the 1905 production, the sum of $51,070 is due to pulpstones, a decrease of $10,250 as compared with the value, $61,320, in 1904; this, however, was an increase of $17,100 as compared with the value, $33,970, in 1903.

The value of the grindstone production was $726,536, a decrease of $93,671 as compared with $820,207, the value in 1904.

In the following table is given the value of the productions of grindstones and pulpstones for the years 1901 to 1905, inclusive:

Value of the production of grindstones and pulpstones, 1901–1905.

	1901.	1902.	1903.	1904.	1905.
Grindstones	$561,903	$644,343	$687,476	$820,207	$726,536
Pulpstones	18,800	23,088	33,970	61,320	51,070
Total	580,703	667,431	721,446	881,527	777,606

In making their reports to the Survey, some of the producers used the ton as the unit of measurement, while others give the actual number of grindstones manufactured. In 1905 the number of grindstones reported, exclusive of pulpstones, aggregated 33,772, valued at $448,799, as against 53,572 stones, valued at $652,717, in 1904. The product reported by weight amounted to 24,429 long tons, valued at $277,737, as against 15,755 tons, valued at $167,490, in 1904. The average value of that portion of the 1905 product reported by weight was $11.37 per ton, an increase of 74 cents per ton as compared with the average value, $10.63 per ton, in 1904. The price per ton reported for the 1905 product varied from $6.67 to $16.50.

In the following table are given the values of the grindstones and pulpstones produced in the United States from 1903 to 1905, by States:

Value of grindstones and pulpstones produced in the United States, 1903–1905, by States.

State.	1903.	1904.	1905.
Ohio	$646,776	$767,552	$644,315
Michigan	70,550	112,500	111,500
West Virginia, Missouri, and Montana	4,120	[a] 1,475	[a] 21,791
Total	721,446	881,527	777,606

[a] Including a small production from Wyoming in 1904 and 1905.

The productions of West Virginia, Missouri, Montana, and Wyoming were all very small as compared with those of Michigan and Ohio. There were a total of 23 producers of grindstones reporting in 1905, of whom 15 were in Ohio, 3 in Michigan, 2 in Missouri, and 1 each in Montana, West Virginia, and Wyoming.

The value of the production of grindstones and pulpstones in the United States from 1880 to 1905, inclusive, is shown in the following table:

Value of grindstones produced in the United States, 1880–1905.

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	1905	777,606

IMPORTS.

The imports consist principally of pulpstones and a few grindstones that are used in the glass and optical trades and are obtained from Newcastle-upon-Tyne, and from Wales and Scotland. In 1905 the value of the imports of grindstones amounted to $113,752, as against $93,152 in 1904. 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 following table is given the value of the grindstones imported into the United States in the last five years:

Grindstones imported and entered for consumption in the United States, 1901–1905.

Year.	Value.	Year.	Value.
1901	$88,871	1904	$93,152
1902	76,906	1905	113,752
1903	85,705		

CANADIAN PRODUCTION.

The grindstone production of Canada has not yet become a very important industry, and in 1905 it only amounted to 5,172 short tons, valued at $57,200, as against 4,509 tons, valued at $42,782, in 1904. The average price per ton in 1905 was $11.06 as against $9.49 in 1904 and $8.73 in 1903.

Production of grindstones in Canada, 1903–1905.

[Short tons.]

Year.	Quantity.	Value.	Average value per ton.
1903	5,538	$48,302	$8.73
1904	4,509	42,782	9.49
1905	5,172	57,200	11.06

INFUSORIAL EARTH AND TRIPOLI.

Although but a small portion of the infusorial earth produced in the United States is used for abrasive purposes, the total production is included under abrasives, as it represents but a small mineral industry. Under this head are included all porous, siliceous earths of organic origin, which are perhaps better described by the term diatomaceous earth on account of the microscopic, siliceous shells of diatoms which they contain. This material is marketed, however, under the name of infusorial earth or tripoli, and abroad by the names of "kieselguhr" and fossil meal. The material, after it is mined, goes through a process of purification in which it is washed, calcined, and pulverized; and it is put on the market in America in a number of forms according to its purity, as shown by varying from pure white to pinkish-white or brownish.

PRODUCTION.

The production of infusorial earth in 1905 amounted to 10,977 short tons, valued at $64,637. This is an increase of 4,703 tons in quantity and of $20,473 in value as compared with the production of 6,274 short tons, valued at $44,164 in 1904. This is the largest quantity reported for any one year since these statistics have been collected. The greatest value was for the production of 1903, when 9,219 tons were valued at $76,273. The States from which this production was obtained, given in the order of their productions and with the number of producers in each, were as follows: Missouri, 2; California, 1; Georgia, 1; New York, 1; Connecticut, 1; Massachusetts, 1; a total of seven producers in six States. Florida, Maryland, New Hampshire, and Virginia, which had outputs in 1904, did not report any in 1905.

In the table following is given the quantity and value of infusorial earth produced in the United States since 1880.

Production of infusorial earth, 1880–1905.

[Short tons.]

Year.	Quantity	Value.	Year.	Quantity.	Value.
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	22,835
1885	1,000	5,000	1898	2,733	16,691
1886	1,200	6,000	1899	4,334	37,032
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	1905	10,977	64,637

IMPORTS.

There is each year 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. In 1905 the value of the imports of rotten stone and tripoli amounted to $18,986, as against $23,022 in 1904, $34,977 in 1903, and $39,296 in 1902. No record is kept by the Bureau of Statistics of the number of tons of this material imported.

OILSTONES AND SCYTHESTONES.

PRODUCTION.

There were no new quarries that produced any oilstones or scythestones during 1905, and the total production was from the old localities in Arkansas, Indiana, Michigan, New Hampshire, Ohio, and Vermont. In New Hampshire and Vermont the material used in manufacturing scythestones is a quartz schist, and in all the other States it is a sandstone which varies widely in texture; the novaculite variety, which is obtained from Arkansas, is the most valuable of any of the abrasives, and the demand for it is in some respects greater than the supply. 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 decided increase in the production of oilstones and scythestones in the United States in 1905 as compared with the production in 1904, but it was far below the production of 1903. The value of the 1905 production was $244,546, which is an increase of $55,561 as compared with $188,985, the value of the production in 1904. As compared, however, with the 1903 production, the value of which was $366,857, it is a decrease of $122,511. 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 in nearly every instance also, with the exception of the novaculite, the raw material would have no value whatever for shipment in the crude condition. It is the value of the finished stones, and not that of the raw material, that is given in these statistics.

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 Michigan. This is the same order as for 1904, with the exception that Kentucky reported no production in 1905 and that there was a small production from Michigan, which did not report any output for 1904.

There is given in the following table the value of the oilstones and scythestones produced in the United States from 1891 to 1905, inclusive:

Value of oilstones and whetstones produced in the United States, 1891-1905.

1891	$150,000	1899	$208,283
1892	146,730	1900	174,087
1893	135,173	1901	158,300
1894	136,873	1902	221,762
1895	155,881	1903	366,857
1896	127,098	1904	188,985
1897	149,970	1905	244,546
1898	180,486		

IMPORTS.

The value of the imports of oilstones and scythestones during 1905 amounted to $65,753, as compared with $61,609 in 1904, an increase of $4,144. The 1905 imports were about one-fourth the value of the domestic production; in 1904 they were about one-third, and in 1903 about one-fifth; and since 1891 the variation in value of imports to domestic production has been from about one-fifth to one-third. The following table shows the total value of all kinds of hones, oilstones, and whetstones imported into the United States in the last five years:

Value of imports of hones and whetstones, 1901-1905.

1901	$64,655	1904	$61,609
1902	56,456	1905	65,753
1903	65,763		

EXPORTS.

There is still a large demand abroad for American scythestones and oilstones, especially for the Arkansas oilstones and the New Hampshire scythestones, which, with smaller quantities of the Indiana oilstones, represent the greater part of the exports. There is no separate record kept of the exports of these stones and therefore no definite valuation can be given, but, as far as can be ascertained, the exports equal or exceed the imports in value.

PUMICE.

About 80 per cent of the pumice used in the United States is shipped directly to this country from the island of Lipari. It occurs there in such enormous quantity that nearly all of the world's demand for pumice is supplied by the deposit in the northwestern part of the island. The cheapness at which it can be mined and loaded on ships and the low price at which it is sold in foreign countries have prevented any extensive development of pumice deposits in other sections of the world. Pumice is known to occur in quantity in many other countries, and in Russia preparations have been made to develop and operate the pumice-stone deposit in the village of Malaya Kutma, about 4 miles from Kars. The pumice occurs within 2½ feet of the surface and is in horizontal strata about 2½ feet thick.[a] It is very pure and fragile, and is found in lumps and partly in triturated, earthy heaps of various sizes. It is being shipped from Kars in two varieties, one the pure pumice in lump form, and the other the triturated variety, which is combined with other foreign matter. The pure

[a] Eng. and Min. Jour., Oct. 14, 1905.

pumice is used for polishing metals, lumber, leather, ivory, etc., as well as for preparing a sort of soap known as pumice soap. The poorer grades are used in the manufacture of hydraulic cement. A certain amount of pumice has been mined in the Canary Islands, but on account of the low price of pumice and the strong competition of the Lipari Island product the mines were finally abandoned.[a]

Pumice deposits have been found in the United States in a number of the States. Their greatest development has been in Nebraska, and on a much smaller scale in South Dakota and Idaho.

PRODUCTION.

During 1905 the production of pumice in the United States amounted to 1,832 short tons, valued at $5,540, or $3,002 per ton. This is an increase of 302 tons in quantity, but of only $119 in value as compared with the production of 1904, which amounted to 1,530 short tons, valued at $5,421, or $3.54 per ton. The price per ton received for the 1905 product is 52 cents less than was received in 1904, and is approximately the same, $3.01, as that received in 1903. Nearly all of this production was used in the manufacture of soap and silver polish, and was obtained from Nebraska, South Dakota, and Idaho. There were 4 producers of pumice in 1905, 2 in Nebraska, and 1 each in South Dakota and Idaho.

In the following table is given the production of pumice in the United States for the years 1902 to 1905, inclusive:

Production of pumice in the United States, 1902–1905.

[Short tons.]

Year.	Quantity.	Value.	Value per ton.
1902	700	$2,750	$3.93
1903	885	2,665	3.01
1904	1,530	5,421	3.54
1905	1,832	5,540	3.02

IMPORTS.

There is no record kept by the Department of Commerce and Labor of the quantity of pumice imported into the United States, only the value of this material being recorded. In 1905 the value of the pumice imported into the United States was $77,489, as against $77,211 in 1904. There is considerable irregularity in the quantity of pumice imported, the imports in certain years being sufficient to satisfy the market for the following year. The importation of pumice since 1902 is given in the following table:

Value of pumice imported into the United States, 1902–1905.

1902	$22,448	1904	$77,211
1903	83,920	1905	77,489

ARTIFICIAL ABRASIVES.

Under this head is included carborundum, crushed steel, and alundum (artificial corundum). The total production of these artificial abrasives in 1905

[a] Oil, Paint and Drug Rep., Jan. 23, 1905.

amounted to 9,820,000 pounds, valued at $701,400, as compared with 11,870,380 pounds, valued at $830,926, in 1904.

CARBORUNDUM.

PRODUCTION.

The production of carborundum in 1905 amounted to 5,596,000 pounds, as compared with 7,060,380 pounds in 1904 and 4,759,890 pounds in 1903. There has been a general growth in the carborundum industry for abrasive purposes, and recently another use has been advocated for carborundum, namely, as a refractory material for furnace linings. As the most refractory variety of carborundum is infusible at 7,000° F. and is unaffected by oxygen, ozone, or sulphur at 3,000° F., its use as a refractory material should meet with success and should furnish a market for a considerable quantity of carborundum. The value of carborundum varies from 7 to 10 cents per pound. The following table shows the quantity of carborundum manufactured since 1892:

Production of carborundum, 1892–1905.

	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	1905	5,596,000

CRUSHED STEEL.

PRODUCTION.

The production of crushed steel in 1905 amounted to 612,000 pounds, valued at $56,840, a decrease of 178,000 pounds in quantity, but an increase of $1,540 in value, as compared with 790,000 pounds, valued at $55,300, in 1904. The prices of the different grades of crushed steel vary from 5½ to 11 cents per pound, and the production of 1905 contained more of the higher grade varieties; hence the increase in the value with a decrease in quantity. In the following table is given the quantity of crushed steel produced each year since 1898:

Production of crushed steel in the United States, 1898–1905.

	Pounds.		Pounds.
1898	660,000	1902	735,000
1899	675,000	1903	755,000
1900	700,000	1904	790,000
1901	690,000	1905	612,000

ALUNDUM OR ARTIFICIAL CORUNDUM.

PRODUCTION.

The production of alundum by the Norton Emery Wheel Company amounted in 1905 to 3,612,000 pounds, valued at $252,840, an average of 7 cents per pound, as compared with 4,020,000 pounds manufactured in 1904. The most of this material is utilized by the Norton Emery Wheel Company in the manufacture of its corundum wheels.

ARSENIC.

By C. C. Schnatterbeck.

INTRODUCTION.

It is surprising that the United States, having extensive deposits of arsenical ores and being the leading consumer in the world, should be dependent for its supplies of arsenic and arsenical compounds largely upon England, Germany, Spain, and Canada. The United States utilizes over half of the world's production of metallic arsenic, white arsenic (arsenious acid), and arsenic sulphides (orpiment and realgar). Another anomaly is the waste by burial in this country every year of several hundred tons of arsenic sulphide which is obtained in purifying sulphuric acid at chemical manufacturing works. This subject offers an opportunity for profitable research to those whose inventive minds may evolve an economical method of treating this arsenious by-product so that it may become of industrial value. It is gratifying to learn that in addition to the arsenic recovered from arsenopyrite mined in Washington and from the ores which occur in Virginia, attempts are being made to recover the arsenic which is going to waste in the smelter fumes at Anaconda, Mont. The United States should yield sufficient raw material to manufacture all the arsenic and arsenical compounds it may need, instead of being obliged to make importations.

OCCURRENCE.

Few mineral substances are as widely diffused through nature as arsenic. And yet there are comparatively few arsenic-bearing deposits which are so favorably situated as to guarantee their successful commercial development. Some of the more important sources of arsenic are the silver ores mined in Saxony, the tin and pyritic ores found in England, the arsenopyrite or mispickel produced in Spain, and the gold-bearing mispickel and nickel-cobalt-silver ores of Ontario. Native metallic arsenic is found occasionally, especially in association with antimony, ruby silver, and some other ores. Among the countries endowed with good deposits of arsenic are Germany, Great Britain, Austria-Hungary, France, Italy, Spain, Portugal, Norway, Siberia, New Zealand, Chile, Mexico, Canada, and the United States.

PRODUCTION.

In 1905 there was produced in the United States 1,507,386 pounds of white arsenic (arsenious acid), valued at $35,210, as compared with 72,413 pounds, valued at $2,185 in 1904. There are signs that the production of arsenic in this country will show marked expansion in the near future, and it is hoped that the chemical manufacturing industry utilizing arsenic will progress also.

The following table shows the production of arsenic in the United States in the last five years:

Production of arsenic in the United States, 1901–5.

[Pounds.]

Year.	Quantity.	Value.
1901	600,000	$18,000
1902	2,706,000	81,180
1903	1,222,000	36,691
1904	72,413	2,185
1905	1,507,386	35,210

The peculiar feature of the domestic industry is the irregularity shown in production, which is unlike the status of the foreign industry as reported in recent years.

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 1900 to 1905, inclusive:

Imports of metallic arsenic, white arsenic (arsenious acid) and arsenic sulphides (orpiment and realgar) into the United States, 1900–1905.

[Pounds.]

Year.	Quantity.	Value.
1900	5,765,559	$265,500
1901	6,989,668	316,525
1902	8,110,898	280,055
1903	8,357,661	294,602
1904	6,800,235	243,380
1905	7,675,088	256,540

PRICES.

The domestic prices for arsenic are based on the fluctuations in the English market, and for the sulphides and chemical compounds on the quotations ruling in Germany. During 1905 the American market showed sales of white arsenic at $2\frac{3}{4}$ to $4\frac{3}{8}$ cents per pound, according to brand. The best prices were realized in the last quarter of the year, when supplies were curtailed by the scarcity of mispickel and by difficulties experienced in mining abroad. Red arsenic, imported largely from Germany, brought $6\frac{3}{8}$ to $7\frac{1}{2}$ cents per pound at New York. Judging from the contracts already placed for 1906 delivery prices will be well maintained for some time to come.

WORLD'S PRODUCTION.

A noteworthy feature of the industry has been the growth in the production of Spain, a country which shipped to the United States in 1905 approximately 1,750 short tons of white arsenic, guaranteed 99.8 per cent of arsenious oxide. The largest producer of metallic arsenic and arsenious oxide in the world is Germany, by far outclassing Great Britain, which until 1902 held first place among the producing countries. Hopes are entertained that Canada may become an important producer with the development of its new deposits of mispickel in Ontario. As for the United States, there are signs that the domestic production of arsenic will show marked expansion in the near future.

The statistics of the world's production of arsenic and its compounds from 1901 to 1905, inclusive, are given in the following table:

The world's annual production of arsenic, 1901-1905.

[Metric tons.]

Year.	Canada.		Germany.[a]		Italy.[a]		Japan.	Portugal.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Quantity.	Value.
1901	630	$41,676	2,549	$256,750	6	$120	10	527	$35,277
1902	726	48,000	2,827	260,000	([b])	([b])	12	736	33,063
1903	233	15,420	2,768	253,500	([c])	([c])	6	698	29,984
1904	[c] 66	6,900	2,800	244,917	([b])	([b])	([b])	1,370	58,887
1905	54	5,400	....	....	....	....	([b])	....	....

[a] Metallic arsenic and arsenious oxide. [b] Statistics not available at time of publication. [c] Exports.

Year.	Spain.[a]		United Kingdom.[b]		United States.[b]	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value
1901	120	$14,400	3,416	$197,270	272	$18,000
1902	([c])	([c])	2,165	93,905	1,226	81,180
1903	1,088	87,040	916	31,750	554	36,691
1904	([c])	([c])	992	27,795	33	2,185
1905	....	....	....	....	684	35,210

[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.

TECHNOLOGY.

Uses.—The greatest demand for arsenic is from manufacturers of Paris green, which is an aceto-arsenite of copper, worth 12 cents per pound at New York. It is used as a pigment, and its poisonous character, while restricting its employment for this purpose, makes it an admirable insecticide in agriculture. It has been often suggested that the silver-lead smelters and refiners who produce appreciable quantities of copper sulphate and can recover arsenic in roasting speiss, should undertake the manufacture of Paris green.

Arsenic also forms colors in yellow, red, and gray, which find a ready sale. In medicine arsenic is used with fevers, rheumatism, some nervous affections, and also as a tonic. A saturated solution of arsenic is recognized as a good wood preserver, and it is also employed as a sheep dip for the purpose of killing parasites which settle in the wool. Weeds are also killed by using an arsenate salt. Hides to be dressed for leather are preserved against the infection of insects by a sprinkling of arsenic. As a conveyer or fixer of aniline colors in calico printing, white arsenic has unique value. It is also utilized, but to a smaller extent in the manufacture of certain kinds of glassware and of high grade enamels.

BORAX.

By Charles G. Yale.

INTRODUCTION.

In the report on borax for 1904 some account was given of the history of this substance as far as its occurrence in the United States is concerned, together with a brief notice of the localities where it has been found. The production of the mineral is now almost entirely confined to the State of California, though small quantities are occasionally derived from the marshes of Nevada, where a little work is carried on during the summer months.

PRODUCTION.

Aside from the nominal output of southwestern Nevada, all the production of borax for 1905 came from the counties of San Bernardino, Inyo, and Ventura, in California. As in other recent years the great bulk of the product was derived from San Bernardino County. The total output of crude borax for the year 1905 was 46,334 short tons, valued at $1,019,154, as against 45,647 short tons, valued at $698,810, in 1904, an increase of 687 tons in quantity, and of $320,334 in value. The average value of the crude borax product in 1905 did not actually increase in this ratio to the somewhat increased quantity, so that an explanation of the figures given is due those whose interests the statistics may serve.

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 $50 a ton, becomes a manufactured product worth on the market from $120 to $140 a ton. When mined and shipped, none of the mineral is pure borax, and about six-sevenths of the total is only 25 per cent ore, the other seventh being more or less concentrated but not refined. The miners themselves agree that in calculating the quantity and value of the production for statistical purposes the crude material only should be considered. The costs of refining vary with the process, justs as costs of mining vary with character of the deposits and with distance of haulage to railroad stations, plus the consequent freight expenses.

The estimate of value for 1905 is the result of an effort to fix a definite and uniform basis for the annual calculation of the value of the output of crude borax at the points of production. From 1882 until 1903 the refined product was used in the estimates of quantity and value, but since then the crude material forms the basis of the statistics. As the great bulk of the crude product is shipped to eastern States for refining, and as prepared borax is essentially a manufactured product, only a portion of the value of this refined article should be credited to California. The quantity of crude material, of greatly varying richness in boric acid, can be reliably known, but difficulties are encountered in estimating the value to be credited to this crude material as it comes from the colemanite veins or marsh deposits.

This product is peculiar among the natural substances of the important mineral industries of the country in that, under the conditions under which the industry is carried on, there exist no ordinary commercial market for the crude product and no actual market basis by which the value of the borax output at the place of production is determined according to the law of supply and demand. Such a basis would be provided were even a few producers engaged in shipping their own crude product to refining plants for sale or custom treatment. Virtually, however, the entire output of crude borax is, and long has been, produced by companies which themselves refine the material for consumption as prepared borax, or use it in their own industrial operations. The entire output is now mined by five companies, and nearly all of it by three companies. These producers have no business occasion to make a separate estimate of the commercial value of the crude borax at the point of production—something quite different from the cost of production. Experienced managers of the industry have been rather puzzled at the problem when its solution has been sought from them.

The valuable element in the crude borax of California is anhydrous boric acid, of which the prepared borax of commerce contains 36.6 per cent, the other elements being soda and water added in the process of refining. The manufactured product is worth from $120 to $140 per ton, but the boric-acid content and its fair commercial value at the place of production are evidently the only proper considerations for the statistical purposes of this service. The crude material as it comes from the ground varies in boric-acid content, according to nature of the deposits, from about 5 per cent to about 35 per cent. Some of the low-grade natural product is concentrated before shipment to the refineries, as costs of transportation by desert roads and by rail are heavy and vary with the location of source of supply. Other factors also enter into the problem of the proportion of value in the finished product represented by the boric-acid content.

Under the conditions the uniform plan of calculating the value of the crude material according to the percentage of boric acid contained has been accepted, and, with the advice of leading producers, it has been assumed that this product in 1905 was worth $120 per ton at the mine, making the crude material worth $1.20 for each unit, or per cent, of boric acid carried. This percentage is reliably known for each mine. Some of this boric acid is used as such in the industries, but the bulk of it goes into the manufacture of borax. Had the entire output been made into borax, the resulting refined product, at an average value of $130 per ton, would be worth $3,016,260.

The accompanying table gives, then, for 1905 the total tonnage of crude material, regardless of its percentage of boric acid. The value, however, is based on the boric-acid content of this crude material. The total value as estimated on this basis shows the production of 8,492 tons of boric acid.

The statistics of production of borax in California from 1895 to 1905, inclusive, are given in the following table:

Production of borax in California, 1895–1905.

[Short tons.]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1895	5,959	$595,900	1901	23,231	$1,012,118
1896	6,754	675,400	1902	[a] 20,004	2,538,614
1897	8,000	1,080,000	1903	[b] 34,430	661,400
1898	8,000	1,120,000	1904	[b] 45,647	698,810
1899	20,357	1,139,882	1905	[b] 46,334	1,019,154
1900	25,837	1,013,251			

[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 1901 to 1905, inclusive:

Imports of borax and borates into the United States, 1901–1905.

[Pounds.]

Year.	Borax.		Borates, calcium, and sodium (crude and refined sodium borate).		Boric acid.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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
1905	166,960	8,802	20,395	1,626	676,105	22,372

WORLD'S PRODUCTION.

The following table gives the production of borax and boron compounds in the principal countries of the world from 1900 to 1904, inclusive:

The world's production of borates, etc., 1900–1904. [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]
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	(g)
1903	31,235	1,206	16,879	....	159	2,583	2,466	(g)
1904	42,034	1,196	....	212	135	2,624	2,675	(g)

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 Annual output estimated at about 9,000 metric tons.

REVIEW OF THE BORAX INDUSTRY DURING 1905.

CALIFORNIA.

The counties of San Bernardino, Inyo, and Ventura, in California, continue to produce the borax derived from the United States, most of it coming from the first-named county. The colemanite deposit in San Bernardino county, owned by the Borax Consolidated (Limited) (Pacific Coast Borax Company), was in 1905, as has been the case for a long period, the most productive of all the mines; but it is considered practically worked out, and the company will in future obtain most of its output from other properties, for which it has been arranging for the last three years. In the same district is the marsh deposit of the American Borax Company, where low-grade material is successfully worked. The Western Mineral Company, near by, works the same class of deposit. In Ventura County the Frazier Borate Company works a colemanite deposit, the ore from which is refined by the Stauffer Chemical Company of San Francisco. The Columbus Borax Company operates a deposit in the same county. The Western Borax Company operates a marsh deposit in Inyo County, where they concentrate and crystallize the material mined.

Along the Mohave Desert and in the Death Valley region of California are numerous small deposits and "prospects" of low-grade character. As experience at Daggett, San Bernardino County, has proven that large quantities of boric acid may be obtained from these low grade muds or marsh deposits, doubtless several of these small mines will eventually be worked when better means of transportation than those of the present day are provided.

San Bernardino County.—In this county the famous colemanite mine of the Pacific Coast Borax Company has continued to be productive, but by no means so much so as in previous years, as far as high-grade ores were concerned. More low-grade material, however, than ever before was mined and the roasters at Marion were therefore run at double capacity. All the ore that averages 35 per cent or more is shipped east directly, but the lower grades are first concentrated at Marion. This company is now manufacturing at its eastern refinery several new products, such as borax soap, talcum powder, bath powder, etc., which, having been well advertised, have caused an increased consumption of borax in the household. The colemanite mine being worked is of a peculiar nature in that it has several times been reported as worked out, but new ore bodies have eventually been found. The mine is not to be abandoned, although the company considers it has passed its climax of high productiveness. The company will in future operate other deposits, as is mentioned in the paragraphs referring to Inyo County.

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 content 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 refined.

The Western Mineral Company, owning mines at Daggett, did not work during 1905, but commenced operations after the close of that year. The Palm Borate Company also owns properties in that vicinity, but made no production in the year under consideration.

Ventura County.—The Frazier Borate Mining Company is mining colemanite near Griffin, and employs 75 men all the year round. The material is shipped to the Stauffer Chemical Company, of San Francisco, at whose works it is refined. The Columbus Borax Company is working colemanite and pandermite ores in this county, and expects to double its output in 1906.

Inyo County.—The Western Borax Company is working marsh dirt or mud near Big Pine. The marsh dirt containing borax is concentrated by boiling and the solution is crystallized. The output is to a certain extent limited by cost and difficulties of transportation, and of late by scarcity of white labor. Activity in the gold mines of the county and across the border in Nevada lured away the white miners, and Chinese had to be brought in to take their places.

The Pacific Coast Borax Company (Borax Consolidated Company, Limited) is carrying to completion in this county improvements which will have a decided effect on the borax industry of the United States. It is building a railroad from Ludlow, San Bernardino County, on the Santa Fe Railroad main line, to Amargosa Valley, in Inyo County, near Death Valley, by which to transport borax from the Lila C. mine. Extensive developments have been going on for several years in the Lila C. mine, where there is a body of colemanite of very fine quality. It has been opened up in a satisfactory manner, but no shipments have ever been made from it, nor will any be made until the railroad is completed. The new railroad will be 131 miles long and is partly built. It will open up a promising mining region before it reaches the borax property, for which it is extended, and it will be extended to Bullfrog, Nev., where it will handle the ores from gold mines in that region. At the Lila C. mine the ore is of character similar to that worked at Borate, in San Bernardino County, but it is cleaner, and there will be less waste in mining. The mine is expected to be a greater producer than the old one at Borate, which has made a large annual output since first opened. The same company owns several other deposits near Death Valley which have never been operated, as some of them doubtless will be on completion of the railroad.

The refiners of borax in the United States are as follows: Borax Consolidated (Limited), Bayonne, N. J.; Pfizer & Co., Brooklyn, N. Y.; Brighton Chemical Company, New Brighton, Pa.; Thos. Thirkelson & Co., Chicago, Ill.; and Stauffer Chemical Company, San Francisco, Cal. For description of the various localities in the different counties of California where borate minerals have been found, reference is made to the Bulletin of the State Mining Bureau, by G. E. Bailey, and to the United States Geological Survey, by M. R. Campbell.[a]

PRICES.

There were no marked changes during 1905 in the prices of either crude or refined borax. In a general way it may be said that the refined material was a trifle lower during 1905 than in 1904. The New York market prices have been, for refined borax, about 6½ to 6¾ cents a pound delivered, which is about half a cent a pound lower than in 1904. For some peculiar reason Chicago buys somewhat cheaper than New York, although the material has to be shipped from California to New Jersey, refined, and then shipped back to Chicago. Nearly all the mines mentioned could increase their output were there reason to do so. Among the producers it is the general opinion that the trouble with the borax business is not the output, but the consumption, which is limited to just so much, irrespective of any price.

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

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[a] Bailey, G. E., The saline deposits of California: Bull. California State Mining Bureau No. 24, 1902. Campbell, M. R., Reconnaissance of the borax deposits of Death Valley and Mohave Desert: Bull. U. S. Geol. Survey No. 200, 1902.

cleansing the hair and it forms part also of numerous cosmetics. Cotton goods saturated with a solution of borate of ammonia and then dried are rendered to a certain extent noninflammable. It is utilized as a mordant in calico printing and dyeing and as a substitute for soap in dissolving gum out of silk. Guignet green, a beautiful pigment used in calico printing, is a borate of chromium. A varnish made of one part borax with five parts shellac is used in stiffening felt hats. With casein, borax forms a substance which is used as a substitute for gum arabic.

A solution of borax in water may be mixed with linseed oil and used for cheap printing. Painters also use a solution of borax as a solvent for shellac. Borate of manganese has been utilized as a drier for paints, oils, and varnishes. Borax is extensively used in tanning where wools and furs are treated, as it cleanses, softens, and prevents the hair from falling out. In the household it is utilized to drive certain insects away, its presence being specially obnoxious to cockroaches and ants. Borax is very extensively used in preserving foods, more particularly canned beef, etc.

In medicine, according to the United States Dispensatory, borax is a mild refrigerant and diuretic. A solution is used as a mild antiseptic. The list of medical preparations into which boric acid and borates enter and form a part is a long one. In chemistry and metallurgy the borates are used in very many ways. With the gradual cheapening of the product in recent years many new uses for it have been found.

The technology of this subject was given at some length in the report for 1904 and nothing new of importance has developed since that time.

BROMINE.

By Frederick J. H. Merrill.

The bromine industry in 1905 [a] was more active than in 1904, and resulted in a greatly increased output, exceeding that of the preceding year by nearly 50 per cent. The larger part of this product was made in Michigan—at Midland, Mount Pleasant, St. Charles, and St. Louis.

The brominiferous brines come from different geologic horizons. In Michigan those of commercial prominence come from the Marshall sandstone of the Upper Carboniferous and contain from 0.1 to 0.3 per cent of bromine. It has, however, been noted that bromine is not confined to the Carboniferous rocks in Michigan, since the deep mine waters of the copper region contain appreciable quantities. At St. Charles, bromine is made from the residues of bitterns of the salt manufacture in connection with the coal industry, one of the mining companies using its exhaust steam to evaporate the salt. At Midland and Mount Pleasant are large works operated by the Dow Chemical Company, which, by special processes controlled by patents, manufactures large quantities of bromine and bromides. The bromine in the brine varies in quantity from 0.1 to 0.2 of 1 per cent and is freed from its usual combinations with alkaline bases by an electric current. The free bromine is removed from the brine by a current of air blown through it, and this bromine is then absorbed from the air by caustic soda. The output by this process in 1905 was more than half of the total product of the United States.

Bromine is made as a by-product in the salt industry at Pomeroy and Syracuse, Meigs County, Ohio, and at Hartford and Mason, Mason County, W. Va., which towns lie along the Ohio River at one of its sharp bends and fall within a circle of a radius of 5 miles. The brine used comes from the Pottsville horizon, which by the well drillers is often called "salt sand," and lies about 1,000 feet below the Pittsburg Coal, resting immediately upon the Lower Carboniferous limestone.

At Malden, on the Kanawha River, a few miles southeast of Charleston W. Va., is another manufactory, also supplied from the Pottsville horizon.

Many of the producers of bromine use a modification of the process for separating bromine described in the report for 1904. The most important difference is that chlorate of potash has been substituted for binoxide of manganese as an oxidizing agent. The treatment consists in first purifying the brine from iron, that would otherwise impart a brown appearance to the salt, then evaporating to produce the salt, and then by further evaporation the mother liquor or "bittern" from the salt crystals is concentrated and run into stone stills, and sulphuric acid and potassium chlorate are added. The sulphuric acid produces

[a] Details in regard to the occurrence of bromine are given in the corresponding report in Mineral Resources for 1904.

from the bittern sufficient hydrochloric acid to react with the potassium chlorate and liberate enough chlorine to free all the bromine. On the application of heat the bromine is liberated, and is distilled off into a lead-pipe condenser. The chemical reactions involved are believed to be as follows:

$$NaCl + H_2SO_4 = NaHSO_4 + HCl.$$
$$6HCl + KClO_3 = KCl + 3Cl_2 + 3H_2O.$$
$$MgBr_2 + 2Cl = MgCl_2 + 2Br.$$

In this process more or less chlorine always accompanies the bromine, frequently to the extent of more than 10 per cent, and further purification is necessary, which consists mainly in the removal of chlorine by redistillation.

At Pittsburg, Pa., there is a plant of average size which extracts bromine from brine derived from the Pocono horizon.

Pennsylvania was the pioneer State in the manufacture of bromine, and began it at Freeport, Armstrong County, in 1846. In Ohio the manufacture began at Pomeroy about 1868. It was also begun at Canal Dover, Tuscarawas County in 1888, but has been abandoned at that point, and is now confined to Pomeroy and the adjacent village of Syracuse.

The uses of bromine, as stated in last year's report, are mainly in the form of alkaline bromides for medicine and photography. Uncombined, it is employed in the manufacture of certain aniline colors, as a disinfectant, and in the metallurgy of gold and silver.

Prices have fallen greatly during the last year. No bromine was sold for more than 16 cents per pound, except on some old contracts. Large lots were sold as low as 14 cents. At an average price of about 15 cents per pound, the total output in 1905 was 1,192,758 pounds, valued at $178,914, as against 897,100 pounds, valued at $269,130, in 1904. The total output for the last twenty-five years has been about 11,250,000 pounds, valued, approximately, at $2,700,000, as appears from the following table of production:

Production of bromine, 1880–1905.

[Pounds.]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1880	404,690	....	1894	379,444	$102,450
1883	301,000	....	1895	517,421	134,343
1884	281,100	$67,464	1896	546,580	144,501
1885	310,000	89,900	1897	487,149	129,094
1886	428,334	141,350	1898	486,979	126,614
1887	199,087	61,717	1899	433,004	108,251
1888	307,386	95,290	1900	521,444	140,790
1889	418,891	125,667	1901	552,043	154,572
1890	387,847	104,719	1902	513,893	128,472
1891	343,000	54,880	1903	598,500	167,580
1892	379,480	64,502	1904	897,100	269,130
1893	348,399	104,520	1905	1,192,758	178,914

FLUORSPAR.

By Edmund Otis Hovey.

OCCURRENCE.

Fluorspar, or fluorite, the fluoride of calcium ($Ca F_2$), although it occurs widely associated with other minerals in veins in many geological horizons, is found in commercially important quantities in but few places within the United States, though there are reported to be other deposits which could be exploited to advantage if transportation facilities were adequate.

The principal fluorspar-producing deposits of the country are in Caldwell, Livingston, and Crittenden counties, Ky., and Hardin and Pope counties, Ill., though there have been reports of valuable prospects in neighboring counties. Colorado has begun to be an important producer, and a small but increasing production is reported from western Tennessee. Arizona, which has reported the production of varying quantities of fluorspar in recent years, dropped out of the producing list in 1905, assessment work being all that was done upon the prospects there.

The fluorspar-bearing belt of the Kentucky-Illinois district forms a zone of Mississippian (Lower Carboniferous) limestone about 75 miles long, from northwest to southeast, and 30 miles wide. The geology of the district and its ore deposits have been fully described in recent years by Emmons,[a] Bain,[b] and Ulrich and Smith,[c] and abundant reference to the remaining important literature of the subject may be found in their papers.

The ore deposits of the Kentucky-Illinois fluorspar district occur in veins along fissures produced by faulting of the sedimentary rocks. The principal mineral occurring in the veins is fluorspar, the remarkable abundance of which is the striking characteristic of the district. Calcite, quartz, and barite are likewise abundant. Kaolin is occasionally associated with these minerals. The original metallic minerals of the veins are galena, the sulphide of lead; blende, or ''jack,'' the sulphide of zinc; pyrite and marcasite, sulphides of iron; chalcopyrite, the sulphide of copper and iron; and stibnite, a sulphide of antimony. Few secondary minerals have been reported. The principal are cerussite, carbonate of lead; smithsonite, carbonate of zinc; limonite, hydrous oxide of iron; malachite, hydrous oxide of copper; and native copper. Still other minerals which have been reported from the region are ankerite, wad, greenockite, calamine, hydrozincite, pyromorphite, sulphur, and some hydrocarbons.

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[a] Emmons, S. F., Fluorspar deposits of southern Illinois: Trans. Am. Inst. Min. Eng., vol. 21, 1893, pp. 31-53.

[b] Bain, H. F., The fluorspar deposits of southern Illinois: Bull. U. S. Geol. Survey No. 255, 1905; Principal American fluorspar deposits: Min. Mag., vol. 12, 1905, pp. 115-119.

[c] Ulrich, E. O., and Smith, W. S. T., The lead, zinc, and fluorspar deposits of western Kentucky: Prof. Paper U. S. Geol. Survey No. 36, 1905.

The veins are of unusual thickness, frequently 10 to 12 feet, and occasionally 25 feet or more, and are remarkable for the great abundance and the purity of the fluorite. The lead and zinc minerals are present in such small quantities that they would not pay for the exploitation of the veins; but at some of the mines the metallic ores are saved as a by-product in the extraction of the fluorspar. The remaining minerals above noted are of no economic importance.

The fluorite usually occurs in sheets which do not show crystal forms, but here and there there are vugs—open spaces—which are lined with well-developed crystals. The octahedral cleavage of the mineral is always in evidence. The fluorite is usually white or colorless, but purple, yellow, and green varieties are common, though green has not been found in Kentucky. Much of the fluorspar shows a banded structure, due to differences in color. The colors of the mineral are generally held to result from the presence of hydrocarbons, and Smith thinks that the purple color is an effect of the oxidation of a hydrocarbon, which is present even in the white spar. Some of the specimens are of very brilliant luster.

Bain believes that the deposits will prove permanent to greater depths than can be economically worked, and that the low price of the ore will in most places preclude exploitation below 1,000 feet from the surface. The largest and deepest mines now in operation are at Rosiclare, Ill., where the veins have been worked to a depth of 300 feet. The Kentucky mines have not gone so deep, none of them being below 150 feet from the surface. The pinching out of some of the Kentucky deposits below that depth, which was reported in 1904, caused the closing of several heretofore important mines. That the mines, however, are not exhausted is shown by prospecting work which has proved the existence of large bodies of first quality spar at greater depths than have yet been reached by the Kentucky mines. This loss, however, has been more than made up by increased production from other deposits. A peculiarity of the Kentucky-Illinois district is the association of basic igneous dikes with the veins of fluorspar, particularly in the vicinity of the Ohio River.

A small quantity of fluorspar was shipped in 1905 from Smith County, Tenn. The Tennessee mineral, which is of high grade, occurs in Trousdale and Smith counties in fissure veins, which intersect formations of Ordovician age, and are therefore much older than those outcropping in the Kentucky-Illinois district; but thus far no igneous rocks have been reported from the near vicinity of the ore bodies. It is said that lumps of pure fluorspar 1,500 pounds in weight have been taken from these veins. Deposits of fluorspar, corresponding in every respect with those found in Smith County, Tenn., occur in Mercer, Jessamine, Fayette, and probably other counties in central Kentucky. In most of these Ordovician limestone fissures, however, the fluorspar is rather intimately associated with barite.

The Colorado fluorspar occurs in strong veins near Jamestown, Boulder County, and is reported to be worked by open-cut methods. The region is in the Front Range of the Rocky Mountains, and the rocks are crystallines of Algonkian age associated with moderately basic igneous intrusions (andesites) of later date.

USES.

The highest grade of fluorspar, "American lump No. 1," is pure white or clear pale blue in color and does not contain more than 1 per cent of silica. Such material is used in the manufacture of opalescent glass, in the making of enamels and "agate" ware, and in the production of hydrofluoric acid and other chemical compounds of fluorine. Both lump and ground mineral is shipped for these purposes. The second grade of fluorspar, "American lump No. 2," includes the colored varieties and is limited to a content of not more than 4 per cent of silica. This is sold in lump or gravel form and is used in the manufacture of open-hearth steel, because it imparts great fluidity to the slag. The third grade of fluorspar, "gravel," includes all of the mineral that carries more than 4 per cent of silica and all that is mixed with calcite. This material is used in foundry work on account of the clean character which it gives to iron castings. Through lack of knowledge of this property the demand for fluorspar for foundry work is much less than it should be. Other grades known to the market are "crushed," "ground fine," and "ground extra fine."

PRICES.

The quotations at Pittsburg determine the prices which the Illinois and Kentucky miners receive for their fluorspar, and the Pittsburg quotations are partly controlled by the prices of the foreign fluorspar, which supplies part of the Pittsburg trade and almost the whole of the eastern demand. The Illinois mineral was sold for a considerably higher average price than that from Kentucky. The price of the Illinois crude fluorspar ranged in 1905 from $5 to $8 per short ton, with an average of $5.26, while the Kentucky crude spar ranged from $4 to $5 per ton, with an average of $4.74 per ton. The Tennessee lump spar is of high grade, as is shown by its having realized an average price of $6.62 per short ton. The Colorado fluorspar brought an average price of $7.09 per short ton.

The prices reported as having been received for ground fluorspar in 1905 were from $10 to $12 per short ton, with greater demand for the higher-priced material than could be satisfied. In 1904 the average price received for this material was $8.44 per short ton; in 1903, $9.99, and in 1902, $9.98. Contracts have been made for a still higher price in 1906.

PRODUCTION.

The total production of fluorspar in 1905 is reported at 57,385 short tons, valued at $362,488, most of which came from the mines in Illinois and Kentucky. This is an increase of 20,933 short tons in quantity and of $127,733 in value, as compared with 36,452 short tons, valued at $234,755, in 1904. The production, furthermore, is greater than ever before, surpassing the previous record year, 1902, by 9,367 short tons in quantity and $90,656 in value. The companies report such active demand for fluorspar, particularly for use in open-hearth steel furnaces, that the production for 1906 is likely to exceed greatly that for 1905. The operators in Illinois and Kentucky are seriously hampered in working their mines by the difficulty of getting reliable and competent workmen.

The production of fluorspar in Illinois in 1905 is reported as having been 33,275 short tons, valued at $220,206, an increase of 16,070 short tons in quantity and of $98,034 in value over the reported production of 17,205 short tons, valued at $122,172, in 1904. The reports show that 2,313 short tons of the Illinois product were sold in the ground condition, the remaining being sold as lump and gravel. About 500 short tons are reported as having been mined in Illinois in 1905, but not marketed.

Kentucky has fallen to second place as a producer of fluorspar, the output in 1905 being 22,694 short tons, valued at $132,362. This, however, is an increase of 3,598 short tons in quantity and of $20,863 in value as compared with 19,096 short tons, valued at $111,499, in 1904. About 5,220 short tons of this production were sold in the ground condition, while the remainder was disposed of as lump and gravel. A production of 1,912 short tons mined in 1905, but not marketed, is reported from Kentucky.

The production in Tennessee shows an increase over that reported for 1904, and 25 tons were mined but not sold.

In the following table are given the quantity and value of fluorspar produced and sold in the United States in the years from 1902 to 1905, inclusive, by States:

Production of fluorspar in the United States, 1902–1905, by States.

[Short tons.]

State.	1902.		1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Colorado							1,156	$8,200
Illinois	18,360	$121,532	11,413	$57,620	17,205	$122,172	33,275	220,206
Kentucky	29,030	143,410	30,835	153,960	19,096	111,499	22,694	132,362
Tennessee	[a] 628	[a] 6,872	[a] 275	[a] 2,037	[a] 151	1,084	260	1,720
Total	48,018	271,814	42,523	213,617	36,452	234,755	57,385	362,488

[a] Including production and value in Arizona.

The annual production of fluorspar in the United States since 1882 is given in the following table:

Production of fluorspar in the United States 1882–1905.

[Short tons.]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
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	1905	57,385	362,488

This table shows that there was an increase in the production of fluorspar in the year 1899 of more than 100 per cent over 1898, and that there was also another increase of about 150 per cent in 1902 over the preceding year. From 1902, however, there was a gradual decrease in production with varying conditions as to price realized until 1905, when there was a sudden and great increase in both quantity and value over any previous year.

IMPORTS.

There is no separate statement in the report of the Bureau of Statistics regarding the quantity of fluorspar imported into the United States, hence no comparison can be made between the domestic and the imported production, though it is known that the competition of the foreign product is severely felt. The domestic fluorspar is purer and brings much higher prices than the imported.

The Canadian department of mines reports that no fluorspar was produced in Canada during 1905.

Cryolite.—Considerable quantities of the mineral cryolite are imported from Greenland each year for use in the manufacture of sodium salts. In the processes of manufacture calcium fluoride results as a by-product, and is saved to be sold for use as a flux in open-hearth steel furnaces in the same manner and with the same results as the natural calcium fluoride, or fluorspar. The quantity of the artificial fluoride made depends, of course, upon the quantities of cryolite treated, and is said to be usually from 3,000 to 4,000 short tons per year.

The quantity of cryolite imported during the year 1905 is reported as 1,600 long tons, valued at $22,482, as against 959 tons, valued at $13,708, in 1904, and 7,708 tons, valued at $102,879, in 1903.

GYPSUM AND GYPSUM PRODUCTS.

By Edwin C. Eckel.

COMPOSITION OF GYPSUM.

Chemical composition.—The mineral gypsum, when absolutely pure, is a hydrous sulphate of lime, made up of one molecule of lime sulphate combined with two molecules of water. The chemical formula of gypsum is therefore $CaSO_4 + 2H_2O$. This, when reduced to percentages of weight, corresponds to the following:

$$\text{Gypsum } (CaSO_4 + 2H_2O) = \begin{cases} \text{Lime sulphate } (CaSO_4) \ldots\ldots & 79.1 \\ \text{Water } (H_2O) \ldots\ldots & 20.9 \end{cases}$$

The 79.1 per cent of lime sulphate can, in turn, be considered as being made up of 32.6 per cent of lime (CaO) plus 46.5 per cent of sulphur trioxide (SO_3). Reduced to its ultimate components, the composition of pure gypsum may therefore be represented as follows:

$$\text{Gypsum } (CaSO_4 + 2H_2O) = \begin{cases} \text{Lime } (CaO) \ldots\ldots & 32.6 \\ \text{Sulphur trioxide } (SO_3) \ldots\ldots & 46.5 \\ \text{Water } (H_2O) \ldots\ldots & 20.9 \\ & \overline{100.0} \end{cases}$$

Deposits of gypsum large enough to be worked for plaster are, however, rarely even approximately as pure as this. Gypsum, as excavated for a plaster plant, will usually carry varying and often high percentages of such impurities as clay, limestone, magnesian limestone, iron oxide, etc.

Physical properties.—Pure gypsum is white and, when in the crystalline form, translucent. The impurities which it commonly contains usually destroy its translucency and affect its color, so that the mineral as mined is an opaque, fine-grained mass, varying from white to reddish, gray, or brown in color.

Gypsum can be distinguished from most other minerals by its extreme softness, for even when in the crystalline form it can be readily scratched by the finger nail. When treated with acids it does not effervesce. On heating it loses its water of crystallization and, if previously translucent, becomes a chalky, opaque white. Pure crystalline specimens have a specific gravity [a] of 2.30 to 2.33.

VARIETIES OF GYPSUM.

Owing to differences in form, texture, color, etc., gypsum presents several varieties, some of which have been given distinct names. The ordinary form in which gypsum occurs in the workable deposits is as massive or rock gypsum. Alabaster is a pure white, fine-grained, massive gypsum, occasionally used for statuary, etc. The term selenite is applied to the crystalline, white, almost transparent gypsum which occurs

[a] Clarke, F. W., Constants of nature: Smithsonian Miscel. Collections, 1873, pt. 1, pp. 75, 81, 82.

frequently, but in relatively small quantity, scattered through a deposit of massive gypsum.

Aside from these various forms of rock gypsum, two less massive forms of the mineral are to be noted as being of commercial importance. In certain Western States and Territories, deposits of earthy gypsum, gypsum earth, or gypsite occur. These deposits contain an impure, earthy, granular form of gypsum. Deposits of gypsum sands are also found in the West, being dunes or heaps of fine grains of gypsum.

Anhydrite.—The mineral anhydrite is closely related to gypsum, being an anhydrous lime sulphate, with the formula $CaSO_4$. It therefore corresponds in composition to the product which would be obtained by heating gypsum so strongly as to drive off all of its water of combination. Anhydrite occurs, but usually only in relatively small quantities, in almost all gypsum deposits. Pure specimens have a specific gravity[a] of 2.92 to 2.98.

OCCURRENCE AND ORIGIN OF GYPSUM DEPOSITS.

Rock gypsum occurs in the form of beds, frequently closely associated with beds of rock salt, and almost always interstratified with thin beds of limestone and thicker beds of red shales. Such gypsum beds may vary greatly in extent as well as in thickness. Beds now worked in different American localities, for example, vary from 6 to 60 feet in thickness. The gypsum occurring in the beds frequently contains a considerable percentage of impurities.

Deposits of rock gypsum have been formed by the gradual evaporation, in lake basins or shallow arms of the sea, of waters carrying lime sulphate in solution. If any natural water be evaporated to a sufficient extent it will deposit the salts which it contains, the order in which the various salts are deposited depending principally upon their relative proportions in the water and their solubility. A normal water, whether from stream, lake, or ocean, will carry as its three commonest constituents lime carbonate, lime sulphate, and sodium chloride. If such a water be evaporated, therefore, deposits of limestone, gypsum, and common salt would result; and, as already noted, these three minerals are very common associates in gypsum deposits.

Gypsum-earth deposits consist of masses of small crystals or grains of gypsum, intermingled usually with much clayey matter, sand, etc. Such deposits occur in depressions, and are supposed to be formed by the evaporation of spring waters which have taken up lime sulphate in solution from underlying beds of rock gypsum, only to deposit it again on reaching the surface and being subjected to evaporation.

In certain areas in the West, notably in Arizona and New Mexico, deposits of gypsum sand occur. These deposits are made up of fine grains of gypsum, worn off from outcrops of rock gypsum and carried by the wind to the place of deposition.

GEOLOGIC DISTRIBUTION OF GYPSUM DEPOSITS.

Gypsum has a very wide geological range, but the workable gypsum deposits of the United States occur at only a few geological horizons. The Saline group of the Silurian carries large gypsum deposits, which are worked in New York, Ontario, Ohio, and Michigan. The Lower Carboniferous carries workable gypsum deposits in Virginia, Michigan, and Montana. Most of the deposits west of the Mississippi occur in rocks of Permian or somewhat later age. Three geological series, therefore, carry almost all of the workable gypsum of the United States.

DISTRIBUTION OF GYPSUM DEPOSITS IN THE UNITED STATES.

East of the Mississippi River the producing localities are confined to central and western New York, southwestern Virginia, northern Ohio, and two widely separated areas in Michigan, and a large unworked deposit occurs in Florida. West of that

[a] Clarke, F. W., Constants of nature, loc. cit.

river gypsum deposits are both numerous and widely distributed, and plaster mills are in operation in fourteen of the Western States and Territories.

Alaska.—Mr. C. W. Wright, of the United States Geological Survey, who examined the Alaska gypsum deposits in 1905, has kindly furnished the following note in regard to them.

Gypsum in sufficient quantity to warrant extensive development and extraction is known to occur at only one locality in southeastern Alaska.

The Pacific Coast Gypsum Manufacturing Company owns claims on Gypsum Creek at the head of Iyoukeen Cove, a small bay on the east shore of Chichagoff Island. Here a small bluff of gypsum interbedded with cherty limestone was discovered 1 mile up the creek, and many tons of the rock were quarried. Tests were made which proved this material to be an exceptionally pure gypsum, and further investigations of the deposit have followed. Two tunnels, 600 feet apart, were driven on Gypsum No. 3 claim and in each of these shafts 65 and 75 feet deep were sunk almost entirely in gypsum. At the lower workings the Gypsum bed appears to have an easterly and westerly strike and a dip of 60° to the south. Overlying it are strata of chert-conglomerate, while beneath it beds of cherty-limestone were exposed. From the bottom of the shaft the deposit is exposed by a cross-cut for a width of 90 feet, entering to the north the hanging wall conglomerate, but to the south penetrating a diabase dike. At the upper workings on the south side of the creek two beds of gypsum have been exposed in the shaft. These appear to lie relatively flat, and are separated from each other by a stratum of conglomerate 17 feet thick. The upper bed is 40 feet thick, and at the time of the writer's visit the shaft entered the lower bed for a depth of 12 feet, but had not passed through it. The extent of the deposit was being investigated by drifts starting from the shaft and penetrating the beds in various directions.

The gypsum and conglomerate beds rest unconformably on Upper Carboniferous limestones, and are probably of early Mesozoic age, which is also the age of many of the gypsum deposits in the Western States.

Developments on a large scale by this company are in progress, and a railroad 1 mile in length, which is in course of construction, will transport the gypsum from the mine to bunkers of 1,000-ton capacity to be built on a wharf. The crude product will be loaded directly into hulks or barges and shipped to Puget Sound, where a plaster mill is to be built.

Arizona.—Gypsum can be obtained in quantity at several localities in southern Arizona, the following being particularly noteworthy: (1) In the Santa Rita Mountains, Pima County, southeast of Tucson; (2) in the low hills along the course of San Pedro River, Cochise and Pinal counties; (3) in the Sierrita Mountains, Pima County, south of Tucson; (4) in the foothills of the Santa Catalina Mountains, Pima County, north of Tucson; (5) on the Fort Apache Reservation, Navajo County. Of these localities only the fourth, north of Tucson, has as yet been commercially developed.

California.—In the Tertiary rocks of California gypsum is widely distributed. It is found throughout nearly all the coast ranges, particularly south of San Francisco Bay, in the foothills of the Great Valley, and in the valleys of southern California. Deposits are known to occur in the counties of Fresno, Ventura, Kings, Monterey, Kern, San Luis Obispo, Santa Barbara, Los Angeles, San Bernardino, Riverside, and Orange.

Colorado.—The gypsum-producing localities of Colorado occur at intervals from the northern to the southern border of the State, along the eastern foothills of the Rocky Mountains. Gypsum has been worked extensively near Loveland; beds have also been opened on Bear Creek, near Morrison, and 8 miles to the southeast, on Deer Creek. Quarries have been developed near Perry Park and in the Garden of the Gods, near Colorado City, and also in the vicinity of Canyon. Other deposits, as yet unworked, are known to occur in the central and western parts of the State.

Iowa.—The gypsum of Iowa is confined to a single area of 60 to 70 square miles near Fort Dodge, Webster County. The material occurs in one bed, which varies from 10 to 25 feet in thickness. It has been extensively worked, eight plaster mills being now in operation in the district.

Kansas.—The area in which gypsum is found is an irregular belt extending northeast and southwest across the State. It is naturally divided into three districts, which, from the important centers of manufacture, may be named the northern or Blue Rapids area, in Marshall County; the central or Gypsum City area, in Dickinson and Saline counties; and the southern or Medicine Lodge area, in Barber and Comanche counties. A number of small areas have been developed between these, connecting more or less closely the three main areas. The gypsum is found at Manhattan and north of that city, though not worked. It is worked at Langford, in the southern part of Clay County, and is found near Manchester, in the northern part of Dickinson County. Gypsum is worked near Burns, and has in past years been worked near Peabody and Furley, and large deposits are known near Tampa. Farther south, in Sumner County, a large mill has been operated at Mulvane, and gypsum has been quarried at Geuda Springs. These different localities show an almost continuous belt of gypsum across the State.

Michigan.—Gypsum is at present worked in two distinct areas in Michigan, while a third locality may prove to be of importance in the future. The two producing areas are (1) in the vicinity of Grand Rapids and (2) at Alabaster, near Saginaw Bay. The third, and as yet unexploited, area is near St. Ignace, on the Upper Peninsula.

Montana.—Gypsum is worked for plaster in Cascade and Carbon counties, and is known to occur at many other localities in the State.

Nevada.—At Moundhouse and Lovelocks, in northwestern Nevada, gypsum deposits have been developed. Large deposits also occur in southern Nevada.

New Mexico.—Though gypsum is known to occur in quantity at many points, the only commercial development has been at Ancho, where a plaster mill is now in operation.

New York.—The gypsum in New York State occurs as rock gypsum interbedded with shales and shaly limestones. Several gypsum beds, separated by shales, usually occur in any given section. They are lenticular in shape, but of such horizontal extent that in any given quarry they are usually of practically uniform thickness. Those that are worked vary from 4 to 10 feet in thickness in most of the quarries, but at Fayetteville a 30-foot bed is exposed. The area in which the gypsum-bearing formations are found extends through the central part of the State, the productive portion of the belt including parts of Madison, Onondaga, Cayuga, Ontario, Genesee, Monroe, Livingston, and Erie counties.

The most easterly points at which gypsum has been worked are in Madison County, but the product there is small and is marketed locally for use as land plaster. In Onondaga County, at Marcellus, Fayetteville, and other points, large quarries are operated, part of the product being calcined and part ground for land plaster. The quarries near Union Springs, in Cayuga County, produce principally land plaster, as do those of Phillipsport, Gibson, and Victor, in Ontario County. The gypsum from Mumford, Wheatland, Garbuttville, and Oakfield is used chiefly for calcined plaster.

Ohio.—The gypsum deposits of Ohio which are of economic value, consist of beds of rock gypsum occurring in the northwestern part of the State. On the north shore of Sandusky Bay, in Portage Township, Ottawa County, 1,500 to 2,000 acres of land have been thoroughly prospected with a core drill, and it has been shown that there are from 150 to 200 acres of workable gypsum. On the south shore of the bay, about 2½ miles northwest of the town of Castalia, drilling has shown the presence of another area of workable gypsum, but no developments have yet been undertaken. It is estimated that at the present rate of production the known deposits will last about twenty-five years.

Oklahoma.—The gypsum in Oklahoma may be considered as occurring in four regions: (1) the Kay County region; (2) the main line of gypsum hills, extending from Canadian County northwest through Kingfisher, Blaine, Woods, and Woodward counties to the Kansas line; (3) the second gypsum hills, parallel with the main gypsum hills, and from 50 to 70 miles farther southwest, which extend from the Keechi Hills, in southeastern Caddo County, northwestward through Washita, Custer, Dewey, and Day counties; and (4) the Greer County region, occupying the greater part of western Greer County and the extreme southeastern corner of Roger Mills County.

Oregon.—Gypsum occurs in Oregon in only one known and exploited locality. This is on the eastern border of the State, near the middle point of the boundary line, on a ridge dividing Burnt River and Snake River. A plaster plant located at Lime uses material from this locality.

South Dakota.—In the Black Hills uplift there is brought to the surface an elliptical outcrop of the Red Beds surrounding the high ridges and plateaus of the central portion of the Black Hills. The area is about 100 miles long by 50 miles wide, and the outcrop zone has an average width of 3 miles, except in a few districts where the rocks dip steeply, where it is much narrower. The formation consists mainly of red, sandy shales, with included beds of gypsum at various horizons, some of which are continuous for long distances, while others are of local occurrence. The thickness of the deposits varies greatly, but in some districts over 30 feet of pure white gypsum occur, and nearly throughout the outcrop of the formation it contains deposits of sufficient thickness and extent to have commercial value.

The gypsum is a prominent feature about Hot Springs. Here the principal beds occur about 60 feet above the base of the formation and have a thickness of 33½ feet, exclusive of the 10-foot parting of shale between them, but this thickness diminishes somewhat northward and rapidly southward.

Texas.—The largest area in Texas containing deposits of gypsum lies east of the foot of the Staked Plains, in northern Texas. The beds have an approximately northeast-southwest strike, and extend from Red River to the Colorado in an irregular line, the sinuosities of which are produced by the valleys of the eastward-flowing streams. This belt is a continuation of the deposits in Oklahoma.

In the eastern part of El Paso County, to the east of Guadaloupe Mountains, there is an area of gypsum which extends beyond the border of the State northward into New Mexico. It lies north of the Texas Pacific Railroad and west of Pecos River. In a few localities this great plain of gypsum is overlain by beds of later limestone and conglomerate. The gypsum is conspicuously exposed along the course of Delaware Creek, a stream rising in the foothills of the Guadaloupe Mountains and flowing eastward into the Pecos.

In the Malone Mountains, in El Paso County, there is a third area, which contains notable deposits of rock gypsum. This locality has the advantage of being situated near the Southern Pacific Railway.

Utah.—The more important known deposits occur in the central and southern portions of the State, in Juab County, east of Nephi; in Sanpete and Sevier counties, near Salina; in Millard County, at White Mountain, near Fillmore, and in Wayne County, in South Wash. They are all of the rock-gypsum type, except the one near Fillmore, which is in the secondary form of unconsolidated crystalline and granular gypsum blown up from dry lakes into dunes. Deposits are also known in Emery County, about 40 miles southeast of Richfield; in Kane County, near Kanab; in Grand County, between Grand River and the La Sal Mountains; in Sanpete County, near Gunnison; in the eastern part of Washington County, between Duck Lake and Rockville, and at other places. Recently enormous deposits of gypsum have been reported from Iron County, but at points so far from lines of transportation as to render their exploitation impracticable for the present.

Virginia.—All the workable gypsum deposits of Virginia occur in Washington and Smyth counties in the valley of the North Fork of Holston River. The area within which the known deposits are located is a narrow belt about 16 miles in length, extending from a short distance southwest of Saltville to a point about 3 miles west of Chatham Hill post-office.

The material occurs as rock gypsum, interbedded with shales and shaly limestones of Carboniferous age. The beds of gypsum average 30 feet in thickness at the localities at which they are now worked. The rocks of the district dip at a high angle, usually between 25° and 45°, so that certain wells which have been drilled are in the gypsum for long distances, and accordingly immense thicknesses of gypsum have been erroneously reported, because the inclination of the deposits was not taken into account. Near Saltville the dip of the gypsum beds which are worked is toward the northwest; at the mines farther up the valley the dip is to the southeast.

The development of the gypsum industry in this area has been governed almost entirely by the transportation facilities. The deposits in the upper valley, though extensive and easily workable, have not been largely exploited, owing to the long wagon haul necessary. The deposits at Saltville and Plasterco, which are on a branch of the Norfolk and Western Railroad, have furnished the principal output.

Throughout the entire area the dip of the gypsum beds is so high as to require mining, except at the commencement of the working.

Wyoming.—Though gypsum deposits occur at many localities in the State only two plaster plants are at present in operation. These are located at Laramie and Red Buttes, respectively. A considerable extension of the Wyoming plaster industry may, however, be expected, for the supplies of gypsum are large and accessible.

CANADA.

Gypsum occurs in New Brunswick, associated with Lower Carboniferous limestones, particularly large deposits being shown near Hillsboro, Albert County.

The gypsum deposits of Ontario occur in the form of beds, associated with shales and limestones, in the Salina group. The principal exploited deposits are located along the valley of Grand River, from Paris in Grant County to near Cayuga in Haldimand County.

Extensive gypsum beds also occur in Devonian limestones along the Moose and French rivers, near James Bay, but these deposits are as yet entirely undeveloped.

In Nova Scotia thick beds of gypsum occur near St. John Harbor, Port Bevis, and Baddeck Bay, associated with Carboniferous limestones.

Of the Canadian gypsum deposits, those of New Brunswick and Nova Scotia are of interest to American producers, for they have supplied large quantities of crude gypsum to plaster plants located in the United States. Most of this Canadian gypsum is used in plants located in the seaboard cities, but a considerable quantity of it is calcined as far inland as Syracuse, N. Y.

PRODUCTION.[a]

The gypsum produced in the United States in 1905 amounted to 1,043,202 short tons, valued at $821,967. This tonnage is largely in excess of the production of 1904 (940,917 tons) and slightly larger than the record production of 1903 (1,041,704 tons). The value is given for the gypsum as mined.

In order of production for 1905 the States and Territories are ranged as follows: (1) Michigan, (2) Iowa, (3) New York, (4) Ohio, (5) Texas, (6) Oklahoma, (7) Kansas, (8) Wyoming, (9) Virginia, (10) Oregon, (11) Utah, (12) California, (13) New Mexico, (14) Nevada, (15) South Dakota, (16) Montana. The principal change in rank, as compared with that shown in 1904, is that Iowa has displaced New York from second position.

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[a] Credit is to be given to Miss J. B. Clagett and Mrs. L. L. Kimball for compilation of statistical tables of this report.—D. T. D.

Production of gypsum in the United States in 1905, by States.

	Producers reporting.	Quantity.	Value.	Average price per ton.
		Short tons.		
California, Nevada, Oregon	4	29,155	$39,947	$1.37
Iowa	6	179,016	114,354	.64
Kansas	4	47,276	32,946	.70
Michigan	7	299,585	143,597	.48
New York	10	153,367	151,272	.99
Ohio, Virginia	4	134,276	134,474	1.00
Oklahoma, Texas	4	148,947	148,947	1.00
Utah, Montana, South Dakota, New Mexico	4	24,700	29,500	1.19
Wyoming	3	26,880	26,930	1.00
Total	46	1,043,202	821,967	.79

Production of gypsum in the United States, 1890–1905.

	Short tons.		Short tons.
1890	182,995	1898	291,638
1891	208,126	1899	486,235
1892	256,259	1900	594,462
1893	253,615	1901	633,791
1894	239,312	1902	816,478
1895	265,503	1903	1,041,704
1896	224,254	1904	940,917
1897	288,982	1905	1,043,202

CHEMISTRY OF GYPSUM BURNING.

Pure crude gypsum is a hydrous sulphate of lime, with a chemical formula $CaSO_4+2H_2O$. This corresponds to the composition:

$$CaSO_4+2H_2O=\begin{cases}\text{Lime sulphate } (CaSO_4)\begin{cases}\text{Lime } (CaO) \dots\dots & 32.6\\ \text{Sulphur trioxide } (SO_3) \,. & 46.5\end{cases}\Big\}=79.1.\\ \text{Water } (H_2O) \dots\dots\dots\dots =20.9\end{cases}$$

$$\overline{100.0}$$

If pure crude gypsum be heated to a temperature of more than 212° F. and less than 400° F. a certain definite portion of the water of combination will be driven off, and the gypsum thus partially dehydrated will be plaster of Paris. Plaster of Paris has the formula $CaSo_4+{}^1/_2H_2O$, corresponding to the composition:

$$CaSO_4+{}^1/_2H_2O=\begin{cases}\text{Lime sulphate } (CaSO_4) \dots\dots & 93.8\\ \text{Water } (H_2O) \dots\dots & 6.2\end{cases}$$

Three-fourths of the original water of combination have therefore been driven off in the course of the process. Dehydration to this extent can, as above noted, be accomplished at any temperature between 212° F. and 400° F. In actual practice, however, it is found most economical of fuel and time to carry on the process at the highest allowable temperatures; and 330° to 395° F. may be regarded as the usual limiting temperatures for plaster manufacture.

About 400° F. is a critical temperature, for if gypsum be heated at temperatures much above this it loses all of its water of combination, becoming an entirely anhydrous sulphate of lime and useless as a normal plaster. Under certain conditions, however, gypsum burned at temperatures above 400° F. gains valuable properties.

Recurring to plasters burned at temperatures lower than 400° F., it may be said that if the gypsum is pure the resulting plaster will harden or set very rapidly when mixed with water, reabsorbing sufficient water to regain its original composition of $CaSO_4 + 2H_2O$. Such quick setting, pure plasters are conveniently grouped as plaster of Paris. If, however, the crude gypsum carries a large percentage of impurities, or if certain materials are added to the plaster after burning, the product will set much more slowly. Such slow-setting plasters are of value in structural work, and are marketed under the somewhat misleading name of "cement plasters." The term is unfortunate, because such "cement plasters" are in no way related to the much better known "hydraulic cements" discussed elsewhere in this volume.

CLASSIFICATION OF PLASTERS.

Using the properties above noted as a basis for classification, the group of plasters may be subdivided as follows:

A. Produced by the incomplete dehydration of gypsum, the calcination being carried on at a temperature not exceeding 400° F.
   1. Produced by the calcination of a pure gypsum, no foreign materials being added either during or after calcination—*plaster of Paris.*
   2. Produced by the calcination of a gypsum containing certain natural impurities, or by the addition to a calcined pure gypsum of certain materials which serve to retard the set of the product—*cement plaster.*

B. Produced by the complete dehydration of gypsum, the calcination being carried on at temperatures exceeding 400° F.
   3. Produced by the calcination of a pure gypsum—*flooring plaster.*
   4. Produced by the calcination, at a red heat or over, of gypsum to which certain substances (usually alum or borax) have been added—*hard-finish plaster.*

COMMERCIAL CLASSIFICATION OF PLASTERS.

In the trade the names given above are used quite extensively, but at times in a careless and indefinite fashion.

Calcined plaster commonly means a burned plaster to which no retarder has been added. If the gypsum from which it is made is pure, the resulting calcined plaster will be a plaster of Paris, as defined above. If the gypsum used is impure, however, the resulting calcined plaster will be a cement plaster, as defined above.

Stucco is almost a synonym for plaster of Paris, as it contains no retarder and is made from fairly pure gypsum; but the product handled commercially as plaster of Paris is usually more finely ground than stucco and is as white as possible.

Wall plasters are made by adding not only retarder, but also hair (or some other fiber) to calcined plaster.

Keene's "cement," Parian "cement," etc., are plasters used as hard finishes in buildings.

In the following tables the total product mineral is classified according to the form in which it is placed on the market. A portion of the gypsum is sold by the producers in a crude state; another portion is simply ground (without being calcined) and sold as a low-grade fertilizer under the trade name of "land plaster," and the remainder of the product reaches the market in the form of calcined plaster, wall plaster, etc.

Disposition of gypsum in the United States in 1905, classified as to uses, by States.

[Short tons.]

State.	Sold crude.		Sold crude, ground, as land plaster.		Sold as calcined plaster.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
California, Nevada, and Oregon	2,282	$5,585	....	....	21,194	$108,335	$113,920
Iowa	4,867	9,357	1,349	$2,923	124,018	576,775	589,055
Kansas	10,291	14,181	1,313	2,025	29,952	134,196	150,402
Michigan	24,284	26,532	20,285	22,398	203,313	585,504	634,434
New York	23,333	47,393	8,147	19,598	161,599	704,147	771,138
Ohio and Virginia	....	....	7,802	22,636	34,235	108,373	131,009
Oklahoma and Texas	1,548	1,993	....	....	122,527	466,441	468,434
Utah, Montana, South Dakota, and New Mexico	500	1,000	1,300	4,700	18,365	93,575	99,275
Wyoming	....	....	....	....	21,505	71,560	71,560
Total	67,105	106,041	40,196	74,280	736,708	2,848,906	3,029,227

Disposition of gypsum in the United States, 1901–1905, classified as to uses.

[Short tons.]

Year.	Sold crude.			Sold crude, ground, as land plaster.		
	Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.
1901	68,669	$71,773	$1.05	59,058	$109,551	$1.85
1902	81,455	93,914	1.15	60,791	106,237	1.75
1903	73,912	87,608	1.19	74,601	154,945	2.08
1904	56,137	61,234	1.09	70,167	142,490	2.03
1905	67,105	106,041	1.58	40,196	74,280	1.85

Year.	Sold as calcined plaster.			Total value.
	Quantity.	Value.	Average price per ton.	
1901	399,686	$1,325,317	$3.31	$1,506,641
1902	539,387	1,889,190	3.50	2,089,341
1903	742,543	3,550,390	4.77	3,792,943
1904	665,340	2,580,601	3.88	2,784,325
1905	736,708	2,848,906	3.87	3,029,227

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, 1904 and 1905, by countries.

[Short tons.]

Country from which imported.	1905.		1904.	
	Quantity.	Value.	Quantity.	Value.
France	355	$2,203	378	$1,160
United Kingdom	388	4,868	514	4,869
Nova Scotia and New Brunswick, etc	349,378	353,878	291,404	315,558
Other countries	30	170	49	1,004
Total	350,151	361,119	292,345	322,591

Imports of crude, ground, or calcined (dutiable) gypsum in the fiscal years ending June 30, 1904 and 1905, by customs districts.

[Short tons.]

Customs district into which imported.	1905.		1904.	
	Quantity.	Value.	Quantity.	Value.
Aroostook, Me	24	$33	90	$157
Bangor, Me	282	151	291	156
Bath, Me	1,300	713	698	395
Passamaquoddy, Me	10,009	8,289	9,546	7,447
Boston and Charlestown, Mass	3,710	8,208	8,896	19,073
Gloucester, Mass	358	195	370	198
Fairfield, Conn	252	675	574	1,433
New Haven, Conn	4,087	2,757	2,550	1,680
New York, N. Y	199,008	205,533	168,883	184,160
Newark, N. J	39,295	43,192	25,325	27,970
Perth Amboy, N. J	4,133	5,364	1,501	1,257
Philadelphia, Pa	64,739	69,445	55,222	63,897
Baltimore, Md	5,174	3,705	5,481	4,161
Norfolk and Portsmouth, Va	14,560	10,744	10,830	8,141
Alexandria, Va	2,251	1,407	2,050	1,521
San Francisco, Cal	12	67	2	9
Other districts	955	635	36	936
Total	350,151	361,119	292,345	322,591

Gypsum imported and entered for consumption in the United States 1900–1905.

[Short tons.]

Year—	Ground or calcined.		Unground.		Value of manufactured plaster of Paris.	Total value.
	Quantity.	Value.	Quantity.	Value.		
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
1905	3,889	20,883	399,230	402,328	22,941	446,152

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 1900 is set forth:

The world's production of gypsum, 1900–1904.

[Short tons.]

Year.	France.		United States.		Canada.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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
1904	1,749,875	2,916,483	940,917	2,784,325	298,211	316,436

Year.	Great Britain.		German Empire.		Algeria.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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
1904	262,086	354,138	25,095	17,307	386	169

Year.	India.		Cyprus.	
	Quantity.	Value.	Quantity.	Value.
1900	4,865	$424	....	....
1901	([c])	([c])	7,784	$17,041
1902	([c])	([c])	7,874	17,443
1903	([c])	([c])	11,591	28,796
1904	([c])	([c])	12,449	31,721

[a] Includes Baden. [b] Includes Tunis. [c] Not available.

PHOSPHATE ROCK.

By Edmund Otis Hovey.

INTRODUCTION.

The term phosphate rock as used is applied to several forms of amorphous deposits, consisting to a greater or less degree of phosphate of lime ($3CaOP_2O_5$). The commercial deposits always carry also variable quantities of carbonate of lime and other substances. Trade names have been applied to the several kinds of phosphate rock which are exploited commercially. They are as follows: "Hard rock," "Soft rock," "Land pebble," "River pebble," "Land rock," "River rock," "Black rock" or "Blue rock," "Brown rock," and "White rock."

OCCURRENCE.

Apatite, a crystallized mineral consisting essentially of phosphate of lime, occurs in igneous rocks in many parts of the United States, particularly in St. Lawrence County, N. Y., but nowhere in sufficiently large quantities to pay for mining. Apatite has been mined to some extent in Canada in previous years, but its production has ceased.

Deposits of amorphous phosphate rock are known in various geological horizons from the Silurian to the Tertiary, and they are forming at the present time in many parts of the world. Important deposits have been reported from several States, but all of the domestic supply for 1905 was reported to come from Florida, South Carolina, and Tennessee. Arkansas, which was formerly a producer but dropped out of the list in 1904, has become active again in 1906.

The most important beds of phosphate rock are those of Florida, more than three-fifths of the total tonnage for the United States being produced in this State, with a value nearly two-thirds that of the total production for the country. The phosphate rock of Florida is divided by Eldridge[a] into hard rock, containing about 36.65 per cent phosphoric anhydride (P_2O_5) (corresponding to 80 per cent phosphate of lime); soft rock, usually averaging less than 22.90 per cent phosphoric anhydride (50 per cent phosphate of lime); land pebble, averaging about 32.06 per cent phosphoric anhydride (70 per cent phosphate of lime), and river pebble, averaging 20.61 per cent phosphoric anhydride (45 per cent phosphate of lime) for the Black Creek deposits, and 28.40 per cent (61 per cent phosphate of lime) for the Peace River beds.

The Florida phosphate rock deposits extend in a rather narrow, curved belt at a distance of about 20 miles from the Gulf of Mexico and approximately parallel thereto for nearly 300 miles from near Punta Gorda on the south to a point west of the Apalachicola River on the northwest. The hard rock deposits of the Eocene beds consist of transported materials, but those of the Miocene strata are in place, though there are some bowlders of foreign origin.

[a] Eldridge, George H., A preliminary sketch of the phosphate of Florida: Trans. Am. Inst. Min. Eng., vol. 21, 1892, p. 196.

The soft rock is found associated with the hard rock, but comparatively little attention has been paid to it in recent years, and no production of it has been reported since 1897.

The land pebble and river pebble varieties differ only in the mode of occurrence, which is indicated by their names. The deposits consist of smooth pebbles, which are rarely larger than an English walnut in size. These are white in color, unless they have been affected by percolating water, when they become dark gray or nearly black. The river pebble deposits contain, in addition to the "pebbles," fragments of hard rock, fossil bones, and other material derived from the rocks through which the rivers have flowed.

The origin of the Florida phosphates has given rise to much discussion. Eldridge, in the paper already referred to, says that the evidence derived from the lithological varieties of phosphates and from the differences in their manner of deposition points to a diversified origin and method of development, in which a number of agencies have acted either synchronously or independently, yet with influence one upon another, and that the essential factors in the origin of the rock phosphate are phosphate of lime, carbonate of lime (either as limestone or as highly calcareous marl—a reagent, in the presence of which both phosphate and carbonate of lime are soluble), and water as a carrying agent.

The South Carolina phosphate rock is divided into land rock and river rock, and is found in an irregular elliptical area about 60 miles in longest diameter in the vicinity of Charleston and Beaufort. The beds are usually thin, being rarely more than a foot in thickness, and the phosphate usually occurs in nodules. Vast numbers of bones and teeth, particularly those of sharks, have been found in the beds. The remains indicate that the deposits are of Upper Miocene age. It is probable that the leaching of phosphatic material from these beds has caused the secondary deposit of phosphate in the form of concretions in the swamp bottoms. The South Carolina deposits have been described by Penrose[a] and others, and the influence of swamp waters on the deposits has been discussed by Reese.[b] The average South Carolina phosphate rock contains, according to Penrose, from 55 to 61 per cent phosphate of lime.

The Tennessee phosphate rock occurs in three fairly well-defined varieties or types, which are known as black or blue rock, brown rock, and white rock. The deposits have been carefully studied and thoroughly reported upon by C. W. Hayes.[c] The black rock, or blue rock, as it is generally called by the miners, occurs in strata of Devonian age in Hickman, Maury, Lewis, Perry, Decatur, and Wayne counties in the western middle part of the State, the most important deposits being in Hickman, Maury, Perry, and Decatur counties. Hayes considers that the several varieties of the black phosphate have originated from the slow accumulation of phosphatic organisms on the bottom of an arm of the ocean, and that the material has essentially the form in which it was originally deposited. The beds vary from a fraction of an inch to 2 feet in thickness. The white phosphate rock has been found only in Perry and Decatur counties, and the deposits have been almost entirely worked out. According to Hayes it seems reasonably certain that the rock is entirely a secondary deposit, which had accumulated since the deposition of the Silurian, Devonian, and Carboniferous formations with which it is now associated. The white phosphate is described as occurring in three well-defined varieties: (1) stony, (2) brecciated, and (3) lamellar, of which only the last named has thus far proved commercially valuable. The white phosphate of Tennessee is stated to contain from 27.4 to 33.4 per cent phosphate of lime.

[a] Penrose, R. A. F., jr., Bull. U. S. Geol. Survey No. 46, 1888.
[b] Am. Jour. Sci., 3d ser., vol. 43, 1892, p. 402.
[c] Hayes, C. W., Sixteenth, Seventeenth, and Twenty-first Ann. Repts. U. S. Geol. Survey.

USES.

Phosphate rock is used altogether in the manufacture of artificial fertilizers and chemicals containing phosphoric acid.

PRODUCTION.

The following table gives the production of phosphate rock in the United States from 1902 to 1905, inclusive, based on the marketed product, classified by kinds or grades:

Production of phosphate rock in the United States, 1902–1905, based on the quantity marketed.

[Long tons.]

State.	1902.		1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Florida:								
Hard rock....	429,384	$1,743,694	412,876	$1,988,243	531,087	$2,672,184	577,672	$2,993,732
Land pebble.	350,991	810,792	390,882	885,425	460,834	1,102,993	528,587	1,045,113
River pebble.	5,055	9,711	56,578	113,156	81,030	199,127	87,847	213,000
Total.......	785,430	2,564,197	860,336	2,986,824	1,072,951	3,974,304	1,194,106	4,251,845
South Carolina:								
Land rock....	245,243	753,220	233,540	721,303	258,806	830,117	234,676	774,447
River rock...	68,122	166,505	25,000	62,500	12,000	31,200	35,549	103,722
Total.......	313,365	919,725	258,540	783,803	270,806	861,317	270,225	878,169
Tennessee:								
Brown rock..	....	....	....	....	....	....	438,139	1,509,748
Blue rock....	....	....	....	....	....	....	44,031	121,486
White rock...	....	....	....	....	....	....	689	2,155
Total.......	390,799	1,206,647	460,530	1,543,567	530,571	1,745,054	482,859	1,633,389
North Carolina...	....	....	45	500	....	....	....	....
Pennsylvania....	100	400	....	....	100	200	....	....
Arkansas	550	1,650	2,125	4,600	....	....	....	....
Other States......	70	825	....	....	....	....	....	....
Grand total.	1,490,314	4,693,444	1,581,576	5,319,294	1,874,428	6,580,875	1,947,190	6,763,403

The preceding table shows in general a continued increase in the total quantity and value of the phosphate rock produced in the United States, and the reports received indicate that the demand for the material is increasing more rapidly than the supply. This has led to an increase in the price received per unit of phosphoric acid contained in the rock, and the outlook for the industry is brighter even than it has been heretofore. The consolidation of interests in comparatively few hands which has been noted in previous reports continues.

The reports made to the United States Geological Survey show that the total quantity of phosphate rock marketed from the mines during 1905 amounted to 1,947,190 long tons, valued at $6,763,403, as compared with 1,874,428 long tons, valued at $6,580,875 in 1904, an increase in quantity of 72,762 long tons and in value of $182,528.

The total quantity of phosphate rock mined in 1905 was 2,138,309 long tons, as against 1,991,169 tons mined in 1904 and 1,618,799 tons in 1903.

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, 1880–1905.

[Long tons.]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
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	6,580,875
1892	681,571	3,296,227	1905	1,947,190	6,763,403

PRODUCTION BY STATES.

FLORIDA.

The State of Florida continues to be the largest producer of phosphate rock in the United States, her output during the year 1905 amounting to 61.3 per cent of the total production of the country. Conditions for mining in Florida during the winter and spring of 1905 were unusually favorable. There was less rain than there had been before for years, and the water level was lower than it had been since 1899, consequently there was an unusual production of high-grade phosphate rock during this season. Heavy rains during the summer and consequent high-water level checked the production and reduced it below the average quantity during the latter part of the year. The demand for high-grade rock is steadily increasing, particularly in Europe, with the result that prices are advancing, and before the end of 1905 buyers were making contracts for 1907 and even for 1908. On the other hand, scarcity of common laborers, high wages, and the increased cost of mining due to the heavier overburden combine to check the response that otherwise might be made to the greater demand and higher prices.

All the valuable deposits of high-grade phosphate rock are now thought to have been discovered, and most of them are in the hands of comparatively few holders. These holders are strong companies, which are acting more and more in harmony with one another, and they may be expected not to produce more rock than is needed for the actual requirements of their trade. It is not thought that the high-grade phosphate rock produced by independent miners from new properties will be large enough in quantity to affect the general situation, because the demand is increasing faster than the apparent supply.

The production of land pebble and river pebble increased greatly over the year 1904, but according to the reports received by the United States Geological Survey, the prices received for the product have fallen off.

The comparative production of the last two years in Florida may be summarized as follows: Hard rock, 577,672 long tons, valued at $2,993,732, in 1905, as compared with 531,087 long tons, valued at $2,672,184, in 1904. This represents an increase in quantity (sales) of 8.7 per cent, while the average price, free on board at the mines, increased from $5.03 per long ton in 1904 to $5.18 in 1905.

Land pebble, 528,587 long tons, valued at $1,045,113, in 1905, as compared with 460,834 long tons, valued at $1,102,993, in 1904. This is an increase of 14.7 per cent in quantity, but the average price realized per long ton decreased from $2.39 in 1904 to $1.98 in 1905.

River pebble, 87,847 long tons, valued at $213,000, in 1905, as compared with 81,030 long tons, valued at $199,127, in 1904. This is an increase of 8.4 per cent in quantity, but a slight decrease in average value per ton, from $2.46 in 1904 to $2.42 in 1905.

The reports made to the United States Geological Survey indicate that 192,801 long tons of hard rock were mined but not marketed, and that 52,204 long tons of the stock carried over from previous years were marketed in 1905. Hence the total quantity mined in 1905 was 1,334,703 long tons.

The relative proportions of the different kinds marketed were, approximately, hard rock 48.3 per cent, land pebble 44.3 per cent, river pebble 7.4 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 1905 inclusive, based upon the reports of marketed material:

Quantity and value of phosphate rock marketed in Florida, 1898–1905, classified by grades.

[Long tons.]

Year.	Hard rock.		Land pebble.		River pebble.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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
1905	577,672	2,993,732	528,587	1,045,113	87,847	213,000	1,194,106	4,251,845

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, 1888–1905.

[Long tons.]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
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	1905	1,194,106	4,251,845
1896	495,199	1,547,353	Total	9,733,861	35,880,072
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 1905, as reported to them, were 585,491 long tons, as compared with 494,044 long tons during

1904, an increase of 91,447 long tons, or 18.5 per cent. The condition of the hard-rock industry is indicated by the following table, which gives the number of plants in operation, idle, and in course of construction during the period from 1901 to 1905, inclusive:

Number and condition of hard-rock plants in Florida, 1901–1905.

Year.	In operation.	Idle.	Under construction.	Total.
1901	40	29	3	72
1902	50	17	3	70
1903	48	7	5	60
1904	17	1	1	19
1905	13	0	1	14

The following tables of shipments of Florida phosphate rock, by countries and years, have been taken from the same report of Messrs. Auchincloss Brothers:

The following is the record of shipments to each country for the last four years:

Shipments of Florida hard-rock phosphate, by countries, 1902–1905.

[Long tons.]

Country.	1902.	1903.	1904.	1905.
England	30,068	28,246	37,620	45,962
Scotland	12,430	5,311	12,957	13,858
Ireland	8,850	9,714	10,218	16,250
Germany	264,550	246,824	205,703	266,721
Belgium	41,245	35,400	32,703	32,209
Holland [a]	77,176	73,280	100,603	93,084
Denmark	2,750	11,870	8,450	5,202
Norway and Sweden	10,250	15,862	28,215	33,644
France	3,950	5,865	20,085	11,014
Italy	16,363	18,542	8,040	26,951
Russia	2,600	....	14,866	....
Austria	14,310	9,000	2,200	28,070
Spain	5,964	5,606	5,584	8,325
United States, West Indies, Australia, Japan, Hawaii, etc	2,104	2,352	6,800	4,201
Total	492,610	467,872	494,044	585,491

[a] A large proportion of the shipments to Rotterdam are forwarded to the interior of Germany.

Total shipments of Florida hard-rock phosphate, 1891–1905.

[Long tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
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	414,675	1904	494,044
1895	306,046	1900	348,556	1905	585,491

Shipments of Florida land-pebble phosphate, 1902–1905.

[Long tons.]

	1902.	1903.	1904.	1905.
United Kingdom ports	22,035	29,226	27,945	36,000
Baltic ports	32,785	40,550	76,740	46,305
Continental ports	40,942	41,655	63,610	69,975
Mediterranean ports	34,953	34,630	50,450	64,015
Other foreign ports	5,046	5,700	....	....
Total foreign shipments	135,761	151,761	218,745	216,295
Total domestic shipments	108,800	157,015	133,549	169,620
Total shipments	334,561	308,776	352,294	385,915

There were no foreign shipments of Florida river-pebble phosphate in 1905; the domestic shipments amounted to 90,225 long tons, as against 79,195 long tons in 1904.

SOUTH CAROLINA.

The production of phosphate rock in South Carolina has been falling off year by year since 1893, with the exception of the years 1898 and 1904, when there were increases over the years immediately preceding. During 1905 there was a decrease from 1904 of 24,130 long tons of land rock, which, however, was almost made good by an increase of 23,549 long tons of river rock. The total production of South Carolina phosphate rock in 1905 was 270,225 long tons, valued at $878,169, as compared with 270,806 long tons, valued at $861,317, in 1904. The details of comparison are as follows:

Land rock, 234,676 long tons, valued at $774,447, in 1905, as compared with 258,806 long tons, valued at $830,117, in 1904; river rock, 35,549 long tons, valued at $103,722, in 1905, as compared with 12,000 long tons, valued at $31,200, in 1905. The average price received for land rock advanced from $3.21 per long ton in 1904 to $3.30 per long ton in 1905; that of river rock advanced from $2.60 per long ton in 1904 to $2.92 per long ton in 1905.

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.

[Long tons.]

Year ending—	Land companies.	River companies.	Total.	Year ending—	Land companies.	River companies.	Total.
May 31—				May 31—			
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 value 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, 1897–1905, classified by grades.

[Long tons.]

Year.	Land rock.		River rock.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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
1905	234,676	774,447	35,549	103,722	270,225	878,169
Total	2,253,579	7,015,837	624,525	1,602,930	2,878,104	8,618,767

There has been produced in South Carolina a total of 7,429,161 long tons of land rock and 4,002,911 long tons of river rock, a grand total of 11,432,072 long tons, with a total value of $24,913,333.

TENNESSEE.

The output and value of the phosphate rock produced in Tennessee since the beginning of the industry in 1894 are shown in the following table:

Production of phosphate rock in Tennessee, 1894–1905.

[Long tons.]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
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	1,745,054
1898	308,107	498,392	1905	482,859	1,633,389
1899	424,109	1,177,160	Total	3,673,702	10,724,809
1900	454,491	1,328,707			

As may be seen from this table, the marketed production of the State for 1905 was 482,859 long tons, valued at $1,633,389, as compared with 530,571 long tons, valued at $1,745,054, in 1904. The average value at the mines advanced from $3.29 per long ton in 1904 to $3.38 per long ton in 1905. The details of the production in 1905 are as follows: Brown rock, 438,139 long tons, valued at $1,509,748, averaging $3.45 per long ton; blue rock, 44,031 long tons, valued at $121,486, averaging $2.76 per long ton; white rock, 689 long tons, valued at $2,155, averaging $3.13 per long ton.

About 43,176 long tons are reported as having been sold from the stock carried over from the preceding year, and the stock on hand January 1, 1906, is reported as 95,245 long tons.

The following statement of shipments of Tennessee phosphate rock by water from Pensacola, Norfolk, and Newport News during the last four years has been taken from the reports of Messrs. Auchincloss Brothers.

Shipments of Tennessee phosphate from Pensacola, Norfolk, and Newport News, 1902–1905.

[Long tons.]

	1902.	1903.	1904.	1905.
United Kingdom ports	11,701	10,374	7,571	10,514
Continental ports	35,111	31,956	38,072	32,178
Mediterranean ports	56,106	66,935	71,471	50,402
Total foreign shipments	102,918	109,265	117,114	93,094
Total domestic shipments	....	2,650	5,850	6,831
Total shipments	102,918	111,915	122,964	99,925

PRICES.

During 1905 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, $5.18 per long ton. In 1904 this grade averaged $5.03, and it brought $4.82 in 1903, $4.06 in 1902, $5.23 in 1901, and $5.25 in 1900. Land pebble averaged $1.98 per long ton at the mines in 1905, a marked decline from preceding years. 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, $2.27 in 1903, but increased to $2.39 in 1904. River pebble averaged $2.42 per long ton in 1905, whereas it brought $2.46 per long ton in 1904 and $2 in 1903.

In South Carolina the average price per long ton received for land rock in 1905 was $3.30. In 1904 the average price obtained at the mines was $3.21, $3.09 in 1903, $3.07 in 1902, $3.18 in 1901, and $3.30 in 1900. River rock shows a gain in the average price, $2.92 per long ton being realized in 1905 as compared with $2.60 in 1904, $2.50 in 1903, $2.44 in 1902, $2.56 in 1901, and $2.61 in 1900.

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 and 1905. The average price in 1905 was $3.39 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; 1903, $3.35, and 1904 $3.29.

IMPORTS.

The following table shows the imports of fertilizers of all kinds into the United States for the years 1902–1905, inclusive:

Fertilizers imported and entered for consumption in the United States, 1902–1905.

[Long tons.]

Year.	Guano.		Crude phosphates and other substances used for fertilizing purposes.[a]		Total value.
	Quantity.	Value.	Quantity.	Value.	
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
1905	27,104	379,667	68,309	452,549	832,216

[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 are as follows: 1902, long tons, 225,413 ($1,016,032); 1903, long tons, 158,313 ($773,758); 1904, long tons, 218,957 ($1,050,082); 1905, long tons, 351,053 ($1,850,622).

WORLD'S PRODUCTION.

In the following table will be found a statement of the world's production of phosphate rock from 1902 to 1904, inclusive:

World's production of phosphate rock, 1902–1904, by countries.

[Metric tons.]

Country.	1902.		1903.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Algeria	305,174	$1,220,696	320,843	$1,238,454	343,317	$1,325,104
Aruba (Dutch West Indies)	10,698	(a)	15,749	(a)	23,128	(a)
Belgium	135,850	297,848	184,120	332,250	202,480	252,263
Canada	776	4,953	1,251	8,214	832	4,590
Christmas Island (Straits Settlement)	62,157	(a)	71,218	(a)	72,905	(a)
France	543,900	2,480,454	475,783	2,115,647	423,521	1,909,859
French Guiana	4,298	32,617	7,893	60,023	(b)	....
Norway	2,295	33,822	1,795	24,120	1,456	19,564
Redonda (British West Indies)	132	791	1,102	7,207	1,729	10,498
Russia	(b)	....	(b)	....	(b)	....
Spain	1,150	4,600	1,124	5,968	3,305	19,136
Sweden	3,895	15,659	3,219	8,627	2,929	6,279
Tunis	264,930	1,075,616	352,088	1,260,137	455,197	1,582,165
United Kingdom	87	530	71	423	59	423
United States	1,514,254	4,693,444	1,606,881	5,319,294	1,904,418	6,580,875

a Value not reported. b Statistics not yet available.

SALT.

By Edmund Otis Hovey.

OCCURRENCE.

Common salt occurs in nature as rock salt, or in solution as brine, varying in strength from that of the ocean (2.68 per cent by weight) to that of the Great Salt Lake (18 to 20 per cent) and of the Dead Sea (22 to 24 per cent), and as sundry subterranean brines of different strengths. Natural salt is almost always somewhat impure through presence of small quantities of one or more of the chlorides, sulphates, and carbonates of potassium, calcium, and magnesium. The rock salt of the Holston Valley, Virginia, has been shown to contain 99.55 per cent NaCl; that of Petite Anse, Louisiana, 98.88 per cent.

Salt is not confined to any particular geological horizon, but it is found in nearly all unmetamorphosed sedimentary rocks, including those which are forming at the present day.

DOMESTIC SOURCES.

According to the reports for 1905 received by the United States Geological Survey, salt is produced on a commercial scale in thirteen States and two Territories—Massachusetts, New York, Pennsylvania, Ohio, West Virginia, Michigan, Kansas, Oklahoma, Louisiana, Texas, New Mexico, Idaho, Utah, Nevada, and California.

The nature of the source and the manner of winning the salt from each of these areas may be summarized as follows:

Massachusetts.—Salt is obtained from sea water by simple evaporation in covered vats. In the early history of the country this was an important industry, but the production now has fallen to insignificant proportions.

New York.—Salt is won from beds of rock salt of Upper Silurian age at depths of from 1,000 to 1,300 feet from the surface and from wells, some of which are 2,400 feet deep. The rock salt is dissolved and recrystallized in preparation for culinary purposes. The brine, which is either a natural solution or an artificial solution made by water led to the deposits through wells, is pumped into covered vats where it is concentrated by evaporation, or it is piped to chemical works, where it is used without evaporation. The natural brines of the Syracuse region average about 18 per cent NaCl (Englehardt). The artificial brines run as near saturation (26.5 per cent NaCl at 60° F.) as is practicable.

The salt wells have disclosed deposits of salt of commercial value from 610 to 2,370 feet below the surface,[a] some of which are of great thickness.

Pennsylvania, Ohio, and West Virginia.—Mississippian beds (Berea sandstone horizon) furnish brine to wells in eastern Ohio and adjacent parts of Pennsylvania and West Virginia. There is a productive well in the oil sands of the Kanawha Valley.

Virginia.—Rock salt occurs in strata of Mississippian age at Saltville, in the Holston Valley of southwestern Virginia. Artificial brine is pumped from deep wells which reach the deposit, and is used in a large chemical factory.

[a] See Merrill, F. J. H., New York State Mus. Bull. No. 11, 1893, for an exhaustive account of the salt deposits of New York.

Michigan.—The salt deposits of Michigan lie partly in strata of Silurian age and partly in those at the base of the Mississippian. The deposits which are worked are in the Saginaw and St. Clair valleys. The beds are of rock salt, but they are exploited by means of wells, the artificial brine from which is used directly in chemical works or is evaporated to dryness in a series of covered vats.

Kansas.—The principal commercial source of salt in Kansas is the deposits of rock salt in the Permian strata of the central and south-central part of the State. About one-half the production for 1905 was from direct mining; the remainder was from artificial brine made in wells driven down to the deposits. Salt is also found in salt marshes, or "salines," where it has been brought by leaching from clays associated with the Dakota (Cretaceous) sandstone, and in some of the Pennsylvanian beds of the eastern part of the State.

Louisiana.—The great production of salt in Louisiana is from Cretaceous (Hilgard) beds of rock salt at Petite Anse, in the extreme southern part of the State. The salt is exploited by means of mines with great galleries, each 200 feet long by 75 feet wide and 65 feet high without timbering. Although the deposit covers only a comparatively small area, it is of great thickness. On Jefferson Island, near Petite Anse, Lucas[a] bored 1,833 feet in pure rock salt without reaching the bottom of the deposit. The beds are remarkable for their purity, there being no intercalated beds of clay or other foreign substance and the salt averaging about 99 per cent NaCl.

Oklahoma.—The salt deposits of Oklahoma are in extensive plains along the Cimarron River, in Blaine County, and in the northeastern part of Woods County. Along the Cimarron River there are many springs delivering a clear, saturated solution of common salt almost pure.[b] The salt is won in primitive fashion by evaporation in open vats.

Texas.—Salt occurs in lagoons along the Gulf coast and in many salt lakes or salines throughout Texas, from which much is taken annually. No report of this production reaches the United States Geological Survey. The region of present commercial importance is in Van Zandt and Anderson counties, where salt is made from artificial brines drawn from wells which enter heavy beds of rock salt in Cretaceous strata at several horizons. The salt deposits of the trans-Pecos region of western Texas are described by G. B. Richardson[c] as consisting of salines of considerable extent, open to exploitation by all comers. Much salt is removed annually, but no records have been kept.

New Mexico.—The salt deposits of New Mexico thus far reported are in the shallow lake basins which are to be found in several places in the Territory. Darton[d] describes what is probably the largest of these as being in the west-central part of the Territory, 80 miles south of Gallup, on the main line of the Santa Fe Railroad. The water contains about 26 per cent of salts, mostly NaCl, and the supply is kept up by springs which are believed to rise from the Red Beds, which are usually salt-bearing.

Idaho, Utah, and Nevada.—Throughout the great semiarid and arid region comprised within the boundaries of Idaho, Utah, and Nevada there are extensive surface deposits of salt, some of which are associated with bodies of water, while others are not. The most famous of these is the Great Salt Lake of Utah and its immediate vicinity. The salt is won from the brine by simple open-air evaporation in great shallow artificial ponds, care being exercised not to allow the bitter salts of the lake waters to precipitate.

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[a] Lucas, A. F., Rock salt in Louisiana: Trans. Am. Inst. Min. Eng., vol. 29, 1900, pp. 462–474.
[b] Gould, C. N., The Oklahoma salt plains: Trans. Kan. Acad. Sci., vol. 16, 1900, pp. 181–184.
[c] Richardson, G. B., Salt, gypsum, and petroleum in Trans-Pecos Texas: Bull. U. S. Geol. Survey No. 260, 1905, p. 573.
[d] Darton, N. H., Zuni salt deposits, New Mexico: Bull. U. S. Geol. Survey No. 260, 1905, p. 565.

California.—Salt occurs in vast quantities in the deposits found in the ancient lake basins of the southern part of California, but the only commercially productive deposits of this character have been flooded by the recent diversion of the Colorado River into the Salton Sink and thus removed from consideration. The great production which puts California into the sixth place in order of output among the States comes from the evaporation of sea water, the conditions for which are particularly favorable on the east side of San Francisco Bay in Alameda County.

USES.

In addition to the ordinary uses of salt for culinary purposes, it is largely consumed in the industries of meat packing, fish curing, dairying, and the like. Its use as a preservative is well known. The chlorination of gold ores demands a large quantity. Great quantities of salt in the form of brine are used in the manufacture of soda ash (sodium carbonate), caustic soda, and other salts.

PRODUCTION.

The reported production of common salt in the United States during the year 1905 amounted to 25,966,122 barrels (of 280 pounds), valued at the point of production at $6,095,922. The reported production in 1904 was 22,030,002 barrels, valued at $6,021,222, an increase in quantity of 3,936,120 barrels and in value of $74,700 in 1905 as compared with 1904. The quantity is the largest ever reported, surpassing the previous banner year, 1902, by 2,116,891 barrels. The average net price for 1905 is 23.476 cents per barrel, which is lower than that reported in any previous year. The next lowest average was in the previous record year, 1902, when only 23.769 cents net was realized per barrel. The average price obtained in 1904 was 27.332 cents per barrel. It is of interest, however, to note that the low average price for 1905 is due to the quantity of brine used in chemical works without concentration.

The quantity of brine reported as produced and used as such in 1905 contained the equivalent of 7,869,931 barrels of dry salt, valued at $393,497. An average rate of 5 cents per barrel is considered by the principal producers a fair valuation for this salt at the well, which gives a total value of $393,497 for the brine. Deducting this quantity and value from the grand totals above given, it will be seen that the quantity of dry salt produced in 1905 was 18,096,191 barrels, valued at $5,702,425, an average of 31.512 cents per barrel.

The following table shows the salt production of the United States by grades during the last five years:

Production of salt, by grades, in the United States, 1901–1905.

[Barrels.]

Year.	Table and dairy.	Common fine.	Common coarse.	Packers.	Solar.
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
1905	2,380,808	6,818,690	3,140,384	327,192	487,528

Year.	Rock.	Milling.	Other grades.	Brine.	Total production.	Total value.
1901	3,237,938	72,460	5,003,526	(a)	20,566,661	$6,617,449
1902	2,889,836	127,521	8,900,881	(a)	23,849,231	5,668,636
1903	3,175,521	37,657	3,118,417	(a)	18,968,089	5,286,988
1904	4,369,141	349,421	86,469	4,006,950	22,030,002	6,021,222
1905	4,733,765	....	207,824	7,869,931	25,966,122	6,095,922

a Included under "Other grades."

The most noteworthy feature of the year 1905 was the enormous increase over 1904 in the production of brine. The salt content of this material in 1905 amounted to 7,869,931 barrels, whereas in 1904 the quantity produced (reported) was only 4,006,950 barrels. This increase of more than 96 per cent is an indication of the great expansion of chemical industries during the year 1905. Table and dairy salt shows a slight decrease in quantity produced in 1905 as compared with 1904; common fine is practically the same as in 1904; common coarse shows an increase of more than 20 per cent, and packers an increase of about 240 per cent. Coarse solar shows a decrease of about 60 per cent, due to conditions in California, where this grade brings but $1.25 per short ton, free on board the railway at the works, a price which many salt-pond owners consider an inadequate return for the amount of labor involved. The production of rock salt in 1905 shows an increase of about 8.3 per cent, in spite of a slight falling off at the mines of Louisiana. Milling salt was not reported as having been produced in 1905.

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, 1893–1905.

[Barrels.]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1893	11,897,208	$4,154,668	1900	20,869,342	$6,944,603
1894	12,968,417	4,739,285	1901	20,566,661	6,617,449
1895	13,669,649	4,423,084	1902	23,849,231	5,668,636
1896	13,850,726	4,040,839	1903	18,968,089	5,286,988
1897	15,973,202	4,920,020	1904	22,030,002	6,021,222
1898	17,612,634	6,212,554	1905	25,966,122	6,095,922
1899	19,708,614	6,867,467			

The following table gives the production and value of the salt produced in the United States from 1902 to 1905, inclusive, by States:

Production and value of salt, 1902–1905, by States.

[Barrels.]

State.	1902.		1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
New York	8,523,389	$1,938,539	8,170,648	$2,007,807	8,600,656	$2,101,568	8,359,121	$2,167,931
Michigan	8,131,781	1,535,823	4,297,542	1,119,984	5,425,904	1,579,206	9,492,173	1,851,332
Ohio	2,109,987	593,504	2,798,899	795,897	2,455,829	478,523	2,526,558	565,946
Kansas	2,158,486	514,401	1,555,934	564,232	2,161,819	717,101	2,098,585	576,139
Louisiana	(a)	(a)	568,936	178,342	1,095,850	320,000	1,055,186	303,507
California	682,660	253,085	629,701	198,630	821,557	205,435	664,099	188,330
West Virginia	208,592	97,721	244,236	35,797	575,000	66,470	202,151	74,063
Texas	347,906	143,683	314,000	117,647	376,695	149,246	444,832	142,993
Utah	417,501	270,626	212,955	181,710	253,829	321,301	177,342	135,465
Other States	1,268,929	321,254	175,238	86,942	262,863	82,372	b 946,075	90,216
Total	23,849,231	5,668,636	18,968,089	5,286,988	22,030,002	6,021,222	25,966,122	6,095,922

a Included in "Other States."
b Virginia, Pennsylvania, Oklahoma, Nevada, New Mexico, Massachusetts, and Idaho.

As may be seen from the foregoing table, the chief salt-producing States are Michigan and New York, and the combined output from these two States amounts to more than two-thirds (68.75 per cent) of the total production of the United States. The table also shows that the five leading salt-producing States during 1905 were Michigan, 9,492,173 barrels (36.56 per cent); New York, 8,359,121 barrels (32.19 per cent); Ohio, 2,526,558 barrels (9.73 per cent); Kansas, 2,096,585 barrels (8.07 per cent); and Louisiana, 1,055,186 barrels (4.06 per cent). These five States contributed 90.61 per cent of the total quantity of salt produced in the country during the year.

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 95.7 per cent in 1905, while the consumption of salt imported into the United States decreased from 36.5 per cent of the total in 1880 to 4.3 per cent in 1905. The actual consumption in 1905 was 26,872,700 barrels, that of 1880 was 9,384,263 barrels. In 1880 the production in the United States was 5,961,060 barrels and the imports 3,427,639 barrels; in 1905 the production had increased to 25,966,122 barrels, while the imports had decreased to 1,151,133 barrels.

Supply of salt for domestic consumption, 1880–1905.

[Barrels.]

Source.	1880.	1890.	1900.	1904.	1905.
Domestic production	5,961,060	8,876,991	20,869,342	22,030,002	25,966,122
Imports	3,427,639	1,838,024	1,427,921	1,186,712	1,151,133
Total	9,388,699	10,715,015	22,297,263	23,216,714	27,117,255
Exports	4,436	17,597	53,650	99,743	244,555
Domestic consumption	9,384,263	10,697,418	22,243,613	23,116,971	26,872,700
Increase over preceding year		877,610	1,274,634	3,068,664	3,755,729
Percentage of imports to total consumption	36.5	17.2	6.4	5.1	4.3

IMPORTS AND EXPORTS.

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, and 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 imports were 403,465,945 pounds in 1901; decreased to 369,528,186 pounds in 1902 and to 327,960,707 pounds in 1903; increased to 332,279,481 pounds in 1904, and decreased to 322,317,211 pounds in 1905.

The following table shows the quantity and value of the salt imported and entered for consumption in the United States in the last five years:

Salt imported and entered for consumption in the United States, 1901–1905.

[Pounds.]

Year.	In bags, barrels, and other packages.		In bulk.		For the purpose of curing fish.		Total quantity.	Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.		
1901	117,140,959	$413,896	171,067,229	$165,803	115,257,757	$96,625	403,465,945	$676,324
1902	118,480,793	422,304	151,169,362	138,552	99,878,031	86,698	369,528,186	647,554
1903	72,838,011	259,029	147,635,246	134,714	107,487,450	102,205	327,960,707	495,948
1904	69,657,850	209,509	143,903,175	135,408	118,718,456	122,837	332,279,481	467,754
1905	73,252,959	247,853	155,091,301	153,914	93,972,951	90,422	322,317,211	492,189

Salt of domestic production exported from the United States, 1900–1905.

[Pounds.]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1900	15,021,861	$65,410	1903	25,499,630	$95,570
1901	18,865,247	86,414	1904	27,928,090	113,625
1902	10,188,771	55,432	1905	68,475,356	239,223

In connection with the foregoing tables it is interesting to note the sources from which the imported salt is obtained and also the markets supplied by the exports of domestic salt.

The following table, which gives the imports of salt during the last three fiscal years, together with the country of origin, shows a considerable decrease (nearly 10 per cent) in the year ending June 30, 1905, as compared with the preceding year. This is due principally to the sharp decline in imports from the West Indies (Turks Island), following the general trend of several years.

Imports of salt during the fiscal years ending June 30, 1903, 1904, and 1905.

[Pounds.]

Country from which imported.	1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
United Kingdom	113,828,493	$349,509	98,943,611	$301,696	100,702,646	$291,851
Italy	76,360,106	53,011	106,060,288	75,756	96,197,755	68,756
Canada	8,884,424	26,697	11,102,273	27,529	11,803,725	41,120
West Indies	131,253,695	113,578	105,160,371	89,878	66,403,633	60,717
Other countries	11,816,828	22,171	20,882,959	20,371	33,464,266	34,290
Total	342,143,546	564,966	342,149,502	515,230	308,572,025	496,734

The exports of salt from the United States nearly doubled in the year ending June 30, 1905, as compared with the year ending June 30, 1904, which before was the record year. As may be learned from the following table, the chief features of the fiscal year were the increase of exports to Cuba from 730,021 pounds in 1904 to 15,983,822 pounds in 1905; the increase of exports to Asiatic Russia from 318,550 pounds in 1904 to 11,141,900 pounds in 1905; the increase of exports to Japan from 3,379,256 pounds in 1904 to 4,950,730 pounds in 1905; and the decrease of exports to Quebec, Ontario, Manitoba, etc., from 13,503,496 pounds in 1904 to 8,533,251 pounds in 1905.

Exports of salt during the fiscal years ending June 30, 1903, 1904, and 1905.

[Pounds.]

Country to which exported.	1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
United Kingdom	95,500	$450	314,400	$1,550	22,745	$535
Bermuda	161,248	1,655	204,380	2,069	199,835	1,851
British Honduras	15,608	168	229,247	1,067	26,494	193
Dominion of Canada:						
Nova Scotia, New Brunswick, etc	63,550	648	53,320	690	42,020	551
Quebec, Ontario, etc	5,955,665	18,379	13,503,496	31,258	8,533,251	30,216
British Columbia	1,801,030	8,170	1,543,133	6,203	2,975,921	7,615
Newfoundland and Labrador	49,500	476	122,110	1,133	209,910	2,075
Central American States:						
Costa Rica	142,661	1,440	164,450	1,564	167,504	1,407
Guatemala	78,528	531	974,306	4,526	1,836,913	5,715
Honduras	99,532	827	240,267	1,762	561,488	2,982
Nicaragua	411,767	3,463	384,189	2,978	484,776	3,266
Panama	....	....	137,155	1,190	908,175	5,215
Mexico	1,297,004	11,642	2,673,137	22,821	2,283,925	20,581
West Indies:						
British	82,199	408	47,446	280	21,747	159
Danish	1,650	25	4,160	33	....	....
French	15,887	216	14,775	162	12,700	161
Haiti	6,475	77	1,800	21	600	7
Santo Domingo	34,286	462	38,693	435	28,379	312
Cuba	39,699	317	730,021	3,512	15,983,822	67,297
Colombia	207,810	2,240	166,675	1,253	157,658	827
Japan	5,413,425	15,126	3,379,256	10,890	4,950,730	14,157
Chinese Empire	1,310	17	41,800	187	43,425	150
Russia, Asiatic	182,210	1,119	318,550	1,725	11,141,900	23,039
French Oceania	118,800	1,098	97,045	836	112,485	491
British Australasia	2,350	22	....	....	6,700	30
Philippine Islands	960	13	....	....	32,102	321
British Africa	10,600	67	8,635	82	1,500	15
Other countries	157,126	1,240	116,131	839	139,749	1,208
Total	16,446,380	70,296	25,508,577	99,066	50,886,454	190,376

WORLD'S PRODUCTION.

In the following table the statistics of salt production in the principal countries of the world are shown for the years 1900 to 1904, 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, 1900–1904.

[Short tons.]

Year.	United States.		United Kingdom.		France.[a]		German Empire.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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	2,655,533	5,286,988	2,113,431	2,967,676	1,096,017	3,036,930	1,867,296	4,587,767
1904	3,084,200	6,021,222	2,118,629	2,900,375	1,292,557	3,660,052	1,875,733	4,693,122

[a] Includes product of Algeria.

The world's salt production, 1900-1904—Continued.

Year.	Japan.		Italy.		Austria-Hungary.[a]	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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	630,076	16,180,748
1904	(b)	(b)	511,827	713,595	595,335	16,024,783

Year.	Russia.		Spain.		India.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1900	2,169,332	(c)	495,965	$824,535	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	470,057	707,424	1,231,058	2,481,357
1903	(d)	(d)	471,116	670,247	1,002,221	2,420,260
1904	(d)	(d)	599,292	738,348	1,236,702	(e)

Year.	Canada.		Other countries.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1900	62,055	$279,458	f 81,717	$511,737	13,406,777	$43,884,980
1901	59,428	262,328	f 541,613	2,463,670	13,522,025	45,989,867
1902	63,056	288,581	f 125,467	970,522	13,880,017	45,613,395
1903	62,452	297,517	f 477,000	1,106,000	13,674,341	45,858,300
1904	68,777	318,628	f 584,000	1,543,000	14,727,771	47,620,086

[a] Government monopoly.
[b] Production and value in 1903 used in making up the total for the world's production in 1904.
[c] Value per ton assumed to be the same as in 1899 in making up the total for the world's production for 1900.
[d] Production and value in 1902 used in making up total for world's production in 1903 and 1904.
[e] Value for 1903 used in making up total for 1904.
[f] Probably 600,000 tons should be added annually for countries not furnishing statistics.

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SULPHUR AND PYRITE.[a]

INTRODUCTION.

The sulphur and sulphuric-acid supply of the United States is at present derived from three distinct, though related, sources. The supply is furnished (1) by native sulphur or brimstone, (2) by iron pyrite, mined specially for use as a source of sulphuric acid, and (3) as a by-product from sulphides carrying workable percentages of copper, lead, etc. The statistics furnished in this volume are believed to be complete so far as the first two sources of supply are concerned; but as yet it has not been possible to secure accurate data as to the quantity of acid produced purely as a by-product in the metallurgy of copper and lead.

SULPHUR PRODUCTION.

In 1905 the production of sulphur in the United States amounted to 181,677 long tons, valued at $3,706,560. The bulk of this output was, of course, from Louisiana, while Nevada and Utah produced appreciable tonnages. The development work now being actively carried on in Colorado and Texas did not furnish any commercial production in 1905, but may reasonably be expected to add considerably to the output of 1906.

Production of sulphur in the United States, 1880–1905.

[Long tons.]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1880	536	$21,000	1893	1,071	$42,000
1881	536	21,000	1894	446	20,000
1882	536	21,000	1895	1,607	42,000
1883	893	27,000	1896	4,696	87,200
1884	446	12,000	1897	2,031	45,590
1885	638	17,875	1898	1,071	32,960
1886	2,232	75,000	1899	4,313	107,500
1887	2,679	100,000	1900	3,147	88,100
1888			1901	[b]241,691	1,257,879
1889	402	7,850	1902	[b]207,874	947,089
1890			1903	[b]233,127	1,109,818
1891	1,071	39,600	1904	[b]334,373	3,478,568
1892	2,400	80,640	1905	181,677	3,706,560

[a] The statistical tables of this report were prepared by Miss J. B. Clagett, of this office.—D. T. D.
[b] Includes the production of pyrite.

FOREIGN COUNTRIES.

SULPHUR DEPOSITS OF MEXICO.

A description of the more notable Mexican sulphur deposits, by Manuel Barriga, has recently been published in the Mining Journal (London).

The principal sulphur beds are in Michoacan, San Luis Potosi, Mexico, Puebla, and Vera Cruz. About 87 miles from San Luis Potosi, on the lower slopes of the Angosture Mountains, are layers of sulphur, some of which have been worked to the depth of 60 feet without diminishing in quantity or showing inferior quality. At Tapona, near Guadalcazar, in the same State, there is sulphur, and likewise in the hacienda Peotillos. Michoacan has deposits in Taximaroa, district of Cinapecuaro, where the Humaredas and Azufres hills are situated, the former being thus named because of the exhalation of aqueous vapors rising from springs known as Hervideros, or geysers. These vapors, containing sulphur in great quantity, together with sulphuric and sulphydric acids, form, on coming in contact with the alumina and oxide of iron existing in the springs, an iron alum, which is deposited on the margin of the springs. No sooner do the vapors begin to rise than they become rapidly condensed, and the sulphur falls to the ground in the form of crystals or dust resulting from the decomposition of the sulphuric and sulphydric acids.

The Chillador Volcano, on the same hills, owes its name to the noise made by the vapors exhaled from it when coming in contact with atmospheric currents. The rock around the crater is entirely covered with sulphur and sulphurous lava, which also appears on a small crater, known as the Chillador Nuevo, distant a few hundred feet from the former. This phenomenon may also be noticed at other points in the direction of the volcanic belt. Close to the crater of the Currutaco, the most remarkable volcano of the region, there are several springs of sulphurous waters, and on the west is the Lake de los Azufres, which, in constant ebullition, causes the sulphur to condense on the shores and in the crevices of the rocks, where it is found in a pure and crystallized state. At the distance of about half a mile, in the Jaripeo hacienda, is the Loma del Chino, with springs of the same character; and 2 or 3 miles farther to the northwest is the Gallo Volcano, on the brow of which are numerous vents where sulphur is found. Near by the Palmar Hill has small craters containing sulphur, and others are on the Maritaro, with vents displaying abundant deposits and similar accumulations in the crater of the volcano of that name, under which is Lake Verde, whose bed is covered with sulphur mixed with sulphurous clay. On the lake shore is a large quantity of pulverized and crystallized sulphur, and on the Cerro de los Azufres there are several exceedingly rich beds, which yielded more than 150 tons of sulphur after the product had been refined.

In the State of Mexico, sulphur exists in Temascalcingo, in the Solis Hill at Ixtlahuaca, and in the crater of the Popocatepetl volcano. Puebla has sulphur beds at Chinahutla and Chignahuapan, in the district of Alatriste, and in the vicinity of Atlixco. In the environs of the city of Puebla, between it and the volcanoes adjacent, there are numerous springs, nearly all of which are used for medicinal purposes. Near Tepezala, Aguascalientes, sulphur is found proceeding from the decomposition of the minerals with which it was combined. Queretaro has sulphur in the Canada of Hilitlilla, a few miles west of Guadalajara in Jalisco, on a hill named the Coll; and on the Orizaba and Ixtlalcihuatl volcanoes, in Vera Cruz, and Mexico, sulphur is found in quantities sufficient to yield profitable returns. There are also sulphur beds in Chiapas, Guerrero, Lower California, and Durango, the extensive deposits of Mapimi lying in the last-named State.

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 1899 (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 1899–1904.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Long tons.			*Long tons.*	
1899	554,638	$10,392,415	1902	656,372	$12,702,090
1900	535,522	10,212,903	1903	849,007	16,999,673
1901	572,106	10,734,192	1904		

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 1902 to 1905, inclusive. This table and the table following have been compiled from the annual statements published by Mr. Alfred S. Malcomson, of New York.

Total exports of sulphur from Sicily, 1902–1905.

[Long tons.]

Country.	1902.	1903.	1904.	1905.
United States	168,920	157,068	103,189	69,215
France	67,634	76,076	104,720	100,372
Italy	45,601	45,576	78,694	99,289
United Kingdom	25,475	19,209	17,918	19,123
Greece and Turkey	20,499	22,168	25,377	25,425
Portugal	12,842	18,324	12,434	15,566
Russia	17,294	15,068	15,142	14,297
Germany	25,908	32,569	31,612	27,263
Austria	19,085	17,925	23,374	24,903
Belgium	12,322	14,310	13,627	14,459
Holland	8,648	5,160	8,121	4,405
Sweden, Norway, and Denmark	24,918	28,290	20,110	21,352
Other countries	18,171	23,680	23,949	19,779
Total	467,317	475,423	478,267	455,448

The quality of Sicilian sulphur imported since 1902 has been as follows:

Quality of Sicilian sulphur received at the different ports of the United States, etc., 1902–1905.

[Long tons.]

Port.	1902.		1903.		1904.		1905.	
	Best unmixed seconds.	Best thirds.	Best unmixed seconds.	Best thirds.	Best unmixed seconds.	Best thirds.	Best unmixed seconds.	Best thirds.
New York	76,183	27,045	64,226	19,805	40,035	10,450	25,820	16,240
Philadelphia	3,500	10,399	6,510	11,900	3,725	4,825	800	1,850
Baltimore	9,065	2,400	10,900	2,700	3,370	1,400		
Boston	2,205	2,300	5,822	2,450	10,645	1,750	5,595	1,010
New Orleans		1,000						
Portland, Me	26,328		26,835		23,694		17,900	
Other ports	8,495		5,920		3,295			
Total	125,776	43,144	120,213	36,855	84,764	18,425	50,115	19,100
Total imports	168,920		157,068		103,189		69,215	

The stocks of sulphur on hand in Sicily during the years from 1901 to 1905, inclusive, are shown in the following table:

Stocks of sulphur on hand in Sicily, 1901–1905.

Year.	Long tons.	Year.	Long tons.
1901	302,410	1904	375,115
1902	324,268	1905	455,171
1903	348,903		

PRICES OF SICILIAN SULPHUR.

During 1905 prices ranged as usual for Sicilian sulphur from $19.50 to $22.50 per long ton, ex steamer at New York. The control over this industry is so complete that prices naturally show little of the variation characteristic of industries in which free competition exists.

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 1901:

Sulphur imported and entered for consumption in the United States, 1901–1905.

[Long tons.]

Year.	Crude.		Flowers of sulphur.		Refined.		All other.[a]		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
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
1905	82,961	1,528,136	572	16,037	779	19,960	27	3,352	1,567,485

[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 1903 to 1905, 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, 1903–1905.

[Long tons.]

Countries whence exported and customs districts through which imported.	1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
COUNTRY.						
Canada			1	$25		
England	10,060	$214,456	7,030	157,251	2,322	$51,342
Italy	153,782	2,997,908	149,383	2,833,269	69,196	1,305,605
Japan	16,167	315,833	11,654	218,366	19,887	327,662
Other countries	1,121	21,173	1,104	22,712	59	1,588
Total	181,130	3,549,370	169,172	3,231,623	91,464	1,686,197
DISTRICT.						
Baltimore, Md	11,984	232,780	11,650	223,489		
Boston and Charlestown, Mass	14,362	303,548	19,980	407,811	13,227	269,564
New Orleans, La	609	19,889				
New York, N. Y	98,855	1,917,523	79,119	1,471,412	36,929	693,792
Philadelphia, Pa	11,635	219,081	16,178	307,508	6,505	110,645
Portland, Me	26,559	522,291	31,270	611,752	14,550	277,874
San Francisco, Cal	10,523	208,539	8,310	158,806	15,095	240,040
Willamette, Oreg	4,151	76,283	1,368	28,365	3,419	62,010
All other	2,452	49,436	1,297	22,480	1,739	32,272
Total	181,130	3,549,370	169,172	3,231,623	91,464	1,686,197

WORLD'S PRODUCTION.

The following table shows the estimated quantity of sulphur produced by all countries for the years 1902 to 1904, inclusive:

World's production of sulphur, 1902-1904.

[Metric tons.]

Country.	1902.		1903.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
United States	(a)		(a)		(a)	(a)
Austria	3,721	$18,121	4,475	$20,905	6,288	$27,184
France	8,000	18,914	7,400	15,015	5,447	16,673
Greece	1,391	24,162	1,400	24,375	569	17,571
Hungary	105	2,947	135	3,816	143	4,405
Italy	[b]3,581,671	8,131,732	[b]3,690,532	8,541,225	[b]3,539,444	8,026,347
Japan	18,287	219,993	22,914	284,520		
Russia	1,800	53,557				
Spain	[b]15,442	38,736	38,600	41,730	40,389	44,632
Sweden	74	1,983			35	748

[a] Included with pyrite. [b] Crude rock.

PYRITE PRODUCTION.

In 1905 the production of pyrite amounted to 253,000 long tons, valued at $938,492, as compared with 207,081 long tons, valued at $814,808 in 1904, an increase of 45,919 tons in quantity and of $123,684 in value. The States producing pyrite in 1905 were Virginia, California, Massachusetts, New York, Alabama, Georgia, Ohio, Indiana, and South Dakota, given in the order of their rank as producers. South Dakota, which reported no pyrite in 1904, contributed a small quantity to the output in 1905. The only change in order of rank in 1905 was that New York displaced Georgia for fourth position, the latter State falling to sixth in rank.

COST OF MINING AND MILLING PYRITE.

Recent data [a] on Virginia practice may be summarized as follows:

Cost of mining and milling pyrite.

	Cost per ton hoisted.	
Mining:		
Labor	$0.77	$1.03
Timber	.01	
Powder, etc	.12	
Drill parts, pipe, etc	.01	
Fuel	.06	
Oil and waste	.03	
Tools and supplies	.03	
Milling:		
Labor	.41	.47
Fuel	.04	
Supplies	.02	
General expenses:		
Superintendent, clerk, watchman, etc	.10	.10
Total costs		1.60

[a] Painter, R. K., Pyrites mining and milling in Virginia: Eng. and Min. Jour., September 9, 1905, p. 433.

These costs do not include loading, transportation, taxes, depreciation, selling expenses, etc. Of course the cost per ton of clean ore increases directly as the ratio of concentration. If, for example, the ore is concentrated 2 : 1, the cost of mining and milling, per ton of clean ore, would be double that given in the above table, or $3.20.

Production of pyrite in the United States in 1904 and 1905, by States.

[Long tons.]

State.	1904.		1905.	
	Quantity.	Value.	Quantity.	Value.
Alabama and Georgia	18,369	$76,101	19,928	$71,863
California	26,902	132,905	61,748	247,712
Indiana	4,465	16,242	3,107	11,491
Massachusetts and New Jersey	26,552	115,184	[a]24,155	108,765
New York	5,285	17,705	11,935	39,883
Ohio	4,837	15,918	8,944	32,770
Virginia	120,671	440,753	123,183	426,008
Total	207,081	814,808	253,000	938,492

[a] Includes also the production of South Dakota.

Production of pyrite in the United States, 1882–1905.

[Long tons.]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
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	207,081	814,808
1893	75,777	256,552	1905	253,000	938,492

[a] Includes production of natural sulphur.

IMPORTS.

The quantity and value of pyrite containing less than 3.5 per cent of copper imported into the United States for each year since 1901 is as follows:

Imports of pyrite containing not more than 3.5 per cent of copper, 1901–1905.

[Long tons.]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1901	403,706	$1,415,149	1904	422,720	$1,533,997
1902	440,363	1,650,852	1905	511,946	1,774,379
1903	420,410	1,636,450			

WORLD'S PRODUCTION.

The following table shows the pyrite production in the principal producing countries, and also shows 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 being considerably more reliable.

World's production of iron pyrite and quantity of sulphur displaced, 1900–1904.

[Long tons.]

Country.	1900.	1901.	1902.	1903.	1904.
Spain	350,296	393,397	142,708	153,543	159,292
France[a]	300,170	302,605	313,204	[a]324,212	267,268
Portugal	339,892	331,641	407,173	370,253	377,540
United States	204,615	234,825	207,874	233,137	253,000
Germany	166,724	154,954	162,613	168,307	172,030
Norway	97,387	100,283	101,016	127,887	131,499
Hungary	85,602	92,428	104,806	95,560	95,618
Italy	70,465	87,969	91,704	99,857	110,240
Canada	35,742	31,483	31,800	33,039	12,010
Newfoundland	Nil.	7,532	26,000	42,000	60,200
Russia	22,789	30,248	26,048	(*b*)	(*b*)
United Kingdom	12,279	10,241	9,168	9,639	10,287
Bosnia and Herzegovina	1,673	4,498	5,088	6,484	10,257
Belgium	394	(*b*)	699	709	1,058
Sweden	176	Nil.	(*b*)	7,670	15,705
Total	1,688,204	1,782,104	1,629,901	1,672,297	1,676,004
Sulphur displaced[c]	759,692	801,947	733,455	752,534	754,202

[a] Includes Algeria.
[b] Statistics not available.
[c] Based on estimated 45 per cent of sulphur content.

TOTAL CONSUMPTION OF SULPHUR IN UNITED STATES.

The sulphur content of domestic and imported pyrite, which taken together constitute the total domestic consumption, is given in the following table:

Consumption of sulphur in the United States, 1903–1905.

[Long tons.]

Source.	1903.	1904.	1905.
Domestic sulphur and sulphur content of pyrite	108,967	220,478	274,863
Imported sulphur	191,033	129,532	84,339
Sulphur content of imported pyrite[a]	189,184	190,224	230,376
Total domestic consumption	489,184	540,234	589,578

[a] Based on average sulphur content of 45 per cent.

BARYTES.[a]

PRODUCTION.

In 1905 the production of crude barytes in the United States amounted to 48,235 short tons, valued at $148,803 at the mines. This represents the crude barytes after being taken out and hand-cobbed, ready for shipment to the mill. This production shows a decrease of 17,492 tons in quantity and of $26,155 in value as compared with the production of 1904, which was 65,727 short tons, valued at $174,958. The average price per ton of the 1905 production was $3.08, an increase of 42 cents over the price per ton in 1904 ($2.66), but only a slight increase over the price in 1903 ($3.02). The producing States in 1905 were Missouri, Tennessee, Virginia, North Carolina, and Kentucky, given in the order of their rank as producers. In the following table are given the quantity and value of the production of barytes in the United States in 1903, 1904, and 1905, by States.

Production of crude barytes in 1903, 1904, and 1905, by States.

[Short tons.]

State.	1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Missouri	23,178	$77,712	25,498	$75,552	26,761	$84,095
North Carolina	6,835	21,347	13,413	33,930	5,519	21,545
Tennessee	[a] 14,684	32,691	[a] 15,602	34,024	[a] 9,487	15,325
Virginia	5,700	20,400	11,214	31,452	6,468	27,838
Total	50,397	152,150	65,727	174,958	48,235	148,803

[a] Includes small production from Kentucky.

It will be seen from this table that Missouri shows a slight increase in production and a considerable increase in value. The other States show a decrease in output.

IMPORTS.

In the following table are given the quantity and value of the manufactured and crude barytes imported into the United States since 1901:

Barytes imported and entered for consumption in the United States, 1901–1905.

[Short tons.]

Year.	Manufactured.		Unmanufactured.	
	Quantity.	Value.	Quantity.	Value.
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	6,630	48,658	7,492	27,363
1905	4,803	39,803	14,256	62,459

[a] The statistical compilation of this report was made by Miss J. B. Clagett, of this office.—D. T. D.

The table below gives the kind and value of the imports of various other barium compounds in 1903, 1904, and 1905:

Value of the imports of barium compounds in 1903, 1904, and 1905.

Barium compound.	1903.	1904.	1905.
Witherite, barium carbonate	$35,762	$46,133	$45,073
Barium binoxide	84,549	102,076	111,856
Barium chloride	68,762	43,694	47,386
Blanc fixe, or artificial barium sulphate	35,466	50,901	53,112
Total	224,539	242,804	257,427

MINERAL PAINTS.[a]

INTRODUCTION.

The materials grouped here under the head of mineral paints include such iron ores as are ground and used in the manufacture of metallic paints; ochers and other clays rich in iron, which are used for the yellow and brown pigments (ocher, umber, sienna), and which are occasionally roasted to give red pigments, and fine-grained slates and shales of attractive colors, which are ground for use as paints. Many other minerals or mineral products are used in the paint trade, such as graphite, chrome, whiting, talc, asbestos, barite, etc., but they are disregarded here, being reported in other sections of the volume. Other paints, as venetian red, litharge, white lead, orange mineral, etc., are purely chemical products, and as such do not, strictly speaking, come within the scope of this volume, though a brief statement as to their production is given for comparison. Zinc white is, however, included, as it is made directly from the ore, without previous metallurgical processes.

PRODUCTION.

In 1905 the total production of the natural pigments, consisting of metallic paint and mortar colors, ocher, umber, sienna, zinc white, slate, and carbonaceous shales and schists amounted to 125,202 short tons, valued at $6,245,173, as compared with the production of 1904, which amounted to 115,699 short tons, valued at $5,301,916, showing an increase of 9,503 short tons in quantity and of $943,257 in value.

The following table shows the production of the various mineral paints from 1902 to 1905, inclusive:

Production of mineral paints, 1902–1905.

[Short tons.]

Kind.	1902.[b]		1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Ocher	16,565	$145,708	12,524	$111,625	16,826	$110,602	13,402	$126,351
Umber	480	11,230	666	15,367	522	12,960	689	17,004
Sienna	189	4,316						
Metallic paint	[c]19,020	313,390	25,103	213,109	19,357	204,377	[c]16,489	176,722
Mortar color	8,355	98,729	10,863	101,792	7,525	84,426	10,494	120,430
Zinc white	52,645	4,016,499	62,962	4,801,718	63,363	4,808,482	68,603	5,520,240
Slate[d]	[e]4,071	39,401	7,106	59,029	5,370	53,709	5,181	44,108
Other pigments	[f]11,511	132,453	....	....	2,736	27,360	10,344	240,318
Total	112,836	4,761,726	119,224	5,302,640	115,699	5,301,916	125,202	6,245,173

[a] The compilation of the statistical portion of this report is by Miss J. B. Clagett, of this office.—D. T. D.
[b] 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.
[c] Includes a small quantity of unground material.
[d] Includes mineral black.
[e] Slate and shale ground for pigment.
[f] Chiefly other iron oxide pigments.

OCHER, UMBER, AND SIENNA.

PRODUCTION.

The production of ocher in the United States during 1905 amounted to 13,402 short tons, valued at $126,351, as compared with 16,826 short tons, valued at $110,602, in 1904, a decrease in quantity of 3,424 short tons, but an increase in value of $15,749.

The combined production of umber and sienna amounted to 689 short tons, valued at $17,004, as against 522 short tons, valued at $12,960, in 1904.

Production of ocher in 1902, 1903, 1904, and 1905, by States.

[Short tons.]

State.	1902.		1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
California	580	$3,650	(a)	(a)	412	$4,750	780	$5,900
Georgia	3,688	38,423	5,212	$47,908	4,752	44,142	4,209	43,481
Pennsylvania	9,818	80,259	4,937	34,782	4,077	29,355	7,789	72,360
Vermont	441	4,544	(a)	(a)	2,176	5,200	(a)	(a)
Other States	2,038	18,832	b 2,375	b 28,935	c 5,409	c 27,155	d 624	d 4,610
Total	16,565	145,708	12,524	111,625	16,826	110,602	13,402	126,351

a Included in Other States.
b Including California, Iowa, Vermont, and Virginia.
c Including Arkansas, Iowa, Virginia, and Indian Territory.
d Including Iowa, Vermont, and Virginia.

Production of ocher, umber, and sienna, 1901–1905.

[Short tons.]

Year.	Ocher.		Umber.		Sienna.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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	a 666	15,367			13,190	126,992
1904	16,826	110,602	a 522	12,960			17,348	123,562
1905	13,402	126,351	a 689	17,004			14,091	143,355

a Includes the production of sienna.

IMPORTS.

The imports of ocher, umber, and sienna for the last five years are as shown in the following tables:

Imports of ocher of all kinds, 1901–1905.

[Pounds.]

Year.	Dry.		Ground in oil.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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
1905	10,616,496	91,673	15,985	880	10,632,481	92,553

Imports of umber, 1901–1905.

[Pounds.]

Year.	Quantity.	Value.
1901	[a] 1,565,431	$12,510
1902	[b] 1,899,425	16,133
1903	[c] 2,169,570	18,272
1904	[d] 2,274,926	20,511
1905	[e] 2,587,284	21,224

[a] Includes 3,184 pounds "ground in oil" and 1,562,247 pounds "dry—crude and powdered, washed or pulverized."
[b] Includes 11,999 pounds "ground in oil" and 1,887,426 pounds "dry—crude and powdered, washed or pulverized."
[c] Includes 9,656 pounds "ground in oil" and 2,159,914 pounds "dry—crude and powdered, washed or pulverized."
[d] Includes 13,133 pounds "ground in oil" and 2,261,793 pounds "dry—crude and powdered, washed or pulverized."
[e] Includes 6,783 pounds "ground in oil" and 2,580,501 pounds "dry—crude and powdered, washed or pulverized."

Imports of sienna, 1901–1905.

[Pounds.]

Year.	Dry.		Ground in oil.	
	Quantity.	Value.	Quantity.	Value.
1901	1,106,553	$18,394	13,861	$1,004
1902	1,534,878	27,299	5,921	494
1903	1,873,532	28,447	1,387	123
1904	1,286,301	22,118	5,770	396
1905	1,737,909	26,097	2,886	227

PRODUCTION OF OCHER IN PRINCIPAL PRODUCING COUNTRIES.

France is the largest producer of ocher, and its output usually amounts to more than the combind 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 1901 to 1904, inclusive, as far as the statistics are available:

Production of ocher in principal producing countries, 1901–1904.

[Short tons.]

Year.	United States.		United Kingdom.		France.		German Empire.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1901	16,711	$177,799	16,287	$69,585	39,357	$275,930	77,047	$102,385
1902	16,565	145,708	18,999	112,030	38,326	361,687	15,374	27,863
1903	12,524	111,625	15,848	82,839	37,524	652,811	21,479	53,291
1904	16,826	110,602	17,976	88,656	38,520	639,192	21,062	26,280

Year.	Canada.		Belgium.		Spain.		Cyprus.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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	772	....	....	[a] 3,506	7,499
1904	3,925	24,995	496	1,592	....	....	[a] 2,540	5,531

[a] Umber exports.

METALLIC PAINT.

PRODUCTION.

In 1905 the production of the metallic paint was obtained from the following States, given in the order of their production: Pennsylvania, New York, Tennessee, Ohio, Wisconsin, New Jersey, Virginia, California, and Maryland. The following table gives the statistics of the production of metallic paint and mortar colors from 1903 to 1905, inclusive, by States:

Production of metallic paint and mortar colors in 1903, 1904, and 1905, by States.

[Short tons.]

State.	1903.				1904.		1905.	
	Metallic paint.		Mortar colors.		Metallic paint and mortar colors.		Metallic paint and mortar colors.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Maryland							1,174	$3,812
New York	4,660	$42,180	6,362	$53,619	4,550	$53,150	[a] 7,159	76,990
Ohio	771	12,020			1,750	21,300	1,589	20,360
Pennsylvania	11,120	112,810	1,800	22,200	7,710	107,609	8,596	123,570
Tennessee					5,292	36,071	5,035	36,380
Other States	8,552	46,099	2,701	25,973	[b] 7,580	70,673	[c] 3,430	36,040
Total	25,103	213,109	10,863	101,792	26,882	288,803	26,983	297,152

[a] Includes a small quantity of unground material.
[b] Alabama, New Jersey, and Wisconsin.
[c] California, New Jersey, Virginia, and Wisconsin.

SLATE AND SHALE.

PRODUCTION.

In 1905 the total quantity of slate and shale ground and used as pigments amounted to 5,181 short tons, valued at $44,108. In 1904 the production, including mineral and carbon black, was 5,370 short tons, valued at $53,709.

The annual production of pigments made from slate and shale during the last five years has been as follows:

Quantity and value of slate and shale ground for pigment, 1901–1905.

Year.	Quantity.	Value.
	Short tons.	
1901	4,865	$41,211
1902	4,071	39,401
1903	7,106	59,029
1904 [a]	5,370	53,709
1905	5,181	44,108

[a] Includes mineral and carbon black.

ZINC WHITE.

PRODUCTION.

The production of zinc white has been increasing steadily for several years, and in 1905 the production amounted to 68,603 short tons, valued at $5,520,240, as against 63,363 short tons, valued at $4,808,482, in 1904.

The following table gives the production of zinc white in the United States from 1901 to 1905, inclusive:

Production of zinc white, 1901–1905.

Year.	Quantity.	Value.
	Short tons.	
1901	46,500	$3,720,000
1902	52,730	4,023,299
1903	62,962	4,801,718
1904	63,363	4,808,482
1905	68,603	5,520,240

IMPORTS.

The following table shows the quantity of zinc white, dry and in oil, imported into the United States in the last five years:

Imports of zinc oxide (dry and in oil), 1901–1905.

[Pounds.]

Year.	Dry.	In oil.	Total value.
1901	3,199,778	128,198	$166,908
1902	3,271,385	163,081	167,084
1903	3,487,042	166,034	188,494
1904	2,585,661	224,244	165,110
1905	3,436,367	342,944	236,762

LEAD PAINTS AND VENETIAN RED.

PRODUCTION.

The pigments which have heretofore been noted are true mineral paints, made directly from a crude mineral. Certain other paints are of interest for comparison, though they are in no sense mineral products, being made from a secondary product of one sort or another. Such pigments include white lead (made from pig lead), venetian red (made from iron sulphate), etc.

In the tables following the production and imports of these secondary pigments are given for a series of years:

Production of white lead, sublimed lead, zinc lead, red lead, litharge, orange mineral, and venetian red during 1902, 1903, 1904, and 1905.

[Pounds.]

	1902.		1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
White lead:								
In oil	179,473,588	$9,755,197	125,348,000	$7,482,487	116,664,563	$6,935,620	125,534,000	$7,577,437
Dry [a]	49,841,821	2,222,977	102,424,000	5,355,160	130,027,460	6,821,309	147,818,000	8,261,212
Sublimed lead	9,465,500	449,611	8,592,000	386,640	12,954,000	550,587	13,954,000	732,585
Zinc lead	8,000,000	225,000	9,000,000	247,500	11,558,000	404,530	13,558,000	474,530
Red lead	23,338,252	1,263,112	17,661,000	1,022,754	20,541,190	1,206,073	32,756,000	2,049,888
Litharge	25,510,690	1,298,343	20,642,000	1,116,361	19,677,345	1,084,093	39,756,000	2,307,233
Orange mineral	1,973,521	139,349	1,302,000	100,693				
Venetian red	23,516,000	196,905	14,850,000	134,635	14,898,000	137,737	13,758,000	137,541

[a] Including white oxide.

IMPORTS.

The folllowing table gives the quantity and value of the imports of white lead, red lead, litharge, and orange mineral from 1901 to 1905, inclusive:

White lead, red lead, litharge, and orange mineral imported, 1901–1905.

[Pounds.]

Year.	White lead.		Red lead.		Litharge.		Orange mineral.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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
1905	597,510	34,722	704,402	26,553	117,757	4,139	628,003	31,106

GEOLOGY AND TECHNOLOGY.

By Edwin C. Eckel.

CHEMICAL COMPOSITION OF OCHERS.

Annalyses of a number of American and foreign ochers are presented in the following table. A further series of analyses of Cartersville, Ga., ocher will be found on a later page of this report.

Composition of ochers and allied pigments.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Fe_2O_3	55.84	70.00	63.30	35.00	36.67	42.45	52.92	33.00	56.59	[a] 47.14
SiO_2	32.20	13.00	20.00	47.00	50.00	30.58	2.88	39.00	30.17	24.70
Al_2O_3		3.60	5.00	6.00				15.00	3.79	7.66
CaO									2.65	Trace.
MgO									1.43	Trace.
Alk								0.5		
CO_2									1.73	
H_2O	12.00	13.00	11.70	10.80	10.60	11.85	14.62	11.5	1.62	6.18

[a] Contains also 11.17 per cent manganese dioxide.

1. Cartersville, Ga. Dark brown. Merrill, Rept. U. S. Nat. Mus. for 1899; Ann. Rept. Smithsonian Inst. for 1899, Washington, 1901, p. 240.
2. East Whately, Mass. Deepest yellow. C.U. Shepard, analyst, Bull. U. S. Geol. Survey, No.126, p.101.
3. East Whately, Mass. Deepest yellow. C. U. Shepard, analyst, Bull. U. S. Geol. Survey, No. 126, p. 101.
4. East Whately, Mass. Yellowish brown. C.U.Shepard, analyst, Bull. U.S.Geol. Survey, No.126, p.101.
5. Hancock, Berks County, Pa. Yellow brown. Merrill, loc. cit., p. 240.
6. Northampton County, Pa. Deep red brown. Merrill, loc. cit., p. 240.
7. Brandon, Vt. Dark brown. Merrill, loc. cit., p. 240.
8. Marksville, Va. Mineral Resources U. S. for 1885; U. S. Geol. Survey, 1886, p. 528.
9. "Indian Red." Persian Gulf. Mineral Resources U. S. for 1883–1884, U. S. Geol. Survey, 1885, p. 926.
10. Umber. Cumberland, England. Merrill, loc. cit., p. 243.

PREPARATION OF OCHER AT CARTERSVILLE, GA.

The ocher milling practice at the various plants in the Cartersville district is fairly uniform. As mined, the ocher contains a considerable quantity of coarse sand, with occasional fragments of quartzite. The presence of part of these impurities can be avoided by careful selection during mining, but owing to the manner in which the deposits have originated, the ocher will always contain some sand and quartzite, representing those portions of the original material which have not been entirely replaced. It is the object of the treatment described below to separate from the ocher as much as possible of these impurities.

The ocher, brought in cars from the mines, is either dumped directly into a log washer or dumped on a platform and shoveled into the washer. The log washer consists of a log 12 to 20 feet in length and 8 to 14 inches in diameter. Iron teeth or paddles are set along the log in an irregular spiral. The log revolves in a trough (into which water flows) by power applied to gearing at one end of an axis passing lengthwise through the log. The paddles, during the revolutions of the log, break up the material (crude ocher) fed in and gradually force the solid residue (sand, etc.) to the upper end of the trough, while at the same time the water carries off the lighter portion (containing the ocher and the finer particles of sand and clay) at the lower end of the washer. The ocherous water is led through a series of settling troughs 300 to 800 feet in length, set at a gentle slope. The heavier particles are deposited in these troughs, while the water, still carrying the fine ocher, passes on into large settling tanks. Here it is allowed to stand until the ocher has settled to the bottom. The overlying water, fairly clear, is then drained off through pipes set in the sides of the tanks. The ocher in the tanks is allowed to dry, under the action of the sun, until it is solid enough to be handled. It is then shoveled out and taken to the drying house. The final drying takes place either on racks in the open air or over coils of steam pipe. The latter process is of course quicker, but results in the loss of part of the ocher, as that portion nearest the pipes is dehydrated too much and takes a reddish tint. After drying, the material is finely ground. The machine used for this purpose is a Clark pulverizer or other mill of the same type.

The chemical composition of both the crude and the refined ocher from the Cartersville district is shown in the table of analyses below, made by the N. P. Pratt laboratory, in Atlanta, Ga., and quoted by Prof. T. L. Watson in a recent paper.[a]

Chemical analyses of crude and refined ocher from the Cartersville district, Georgia.

	Samples.							
	1.	2.	3.	4.	5.	6.	7.	8.
Fe_2O_3	72.29	56.29	65.49	54.60	67.37	61.40	67.32	62.79
Al_2O_3	5.55	10.15	7.20	6.68	6.85	7.14	5.86	6.94
FeO	.46	.39	....	....	....	....	....	....
MnO_2	.87	.54	1.80	1.50	2.04	2.00	....	....
SiO_2 (free sand)	6.65	8.94	7.76	17.42	6.54	11.89	9.14	6.20
SiO_2 (combined as silicates)	3.98	9.49	6.85	10.08	6.61	5.84	6.35	9.78
H_2O at 105° C.	.55	2.08	.40	.48	.96	.46	.78	.50
H_2O above 105° C.	9.22	11.34	10.50	9.24	9.63	9.37	9.60	....
Total	99.57	99.22	100.00	100.00	100.00	100.00	99.05	....

1. Crude ocher from Mansfield Brothers' property. Lot No. 462, fourth district, third section, Bartow County, Ga.

2. Crude ocher from the John P. Stegall property, near Emerson, Bartow County, Ga.

3, 4, 5, and 6. Refined ocher from the Blue Ridge Ocher Company's property. Lot No. 490, fourth district, third section, Bartow County, Ga. Furnished by courtesy of the manager, Capt. John Postell, Cartersville, Ga.

7. Refined ocher from the Cherokee Ocher and Barytes Company's property, 1 mile east of Cartersville. Furnished by courtesy of the president, Mr. T. W. Baxter, Atlanta, Ga.

8. Refined ocher from the American Ocher Company's property. Lot No. 475, fourth district, third section, Bartow County, Ga. Furnished by courtesy of the manager, Mr. Waite, Cartersville, Ga.

[a] Trans. Am. Inst. Min. Eng., 1903.

These analyses bring out clearly one fact which has been also noted by the writer when examining iron-ore washers. It is that the log washer is in no sense a concentrator except when the desirable product and the impurity occur in very different sizes. The washer is merely a sizer; it delivers coarse material at its upper end and fines at its lower end, and in nine cases out of ten, whether working in iron ore or on ocher, the waste product from the washer is of just as high grade as the saved product. The real concentration in the ocher-refining process must take place, therefore, in the series of troughs, and when these troughs are too short, or the slope too steep, no concentration at all can be expected. In the analyses given above, for example, it is evident that the crude ocher is just as pure as the refined.

PREPARATION OF METALLIC PAINT IN NEW YORK.

During field work in 1905 the writer was enabled, through the courtesy of Messrs. E. B. Stanley, secretary, and O. J. Roberts, superintendent, to examine the plant of the Clinton Metallic Paint Company. This plant is located on the New York, Ontario, and Western Railroad at Franklin Iron Works, Oneida County, N. Y. The raw material used is the red volitic hematite shipped in from mines near Clinton. It is passed through the following machines in order: (1) Blake crusher, (2) vertical tubular drier, (3) one set Cornish rolls, (4) six run of French buhrstones. The drier is a vertical cylindrical shell, 5 feet in diameter and 18 feet high, with a 2-inch fire-brick lining. Inside this shell are set 4 vertical 14-inch cast-iron tubes, one-half inch thick. The ore is fed from the Blake crusher into the tops of these tubes, and passes downward slowly as it is drawn out at their lower ends, while hot gases circulate in the space between the drier shell and the tubes. The drier, which was designed by Mr. Roberts, holds 4 tons, and is drawn at the rate of 2½ tons per hour.

The dried ore passes to the rolls, which crush it to about one-eighth inch, after which it is sent to the buhrstones. These are either run separately for a coarse product, or else the material is passed through two or three times to secure a fine product.

A sieve test of the products obtained by passing only once through the buhrs gave the following results:

Mesh of sieve.	Per cent passing.	Per cent residue.
75	93	7
100	90	10
150	60	40

In ordinary practice the fines are separated out from the product of the crusher rolls and buhrs by an air blast, and are sent directly to the packing room.

ASBESTOS.

By George Otis Smith.

INTRODUCTION.

Commercial asbestos includes fibrous minerals of two distinct types. The true asbestos is actinolite or tremolite and belongs to the amphibole group, and with it may be placed the other fibrous amphiboles, anthophyllite and crocidolite. The more important asbestiform mineral, however, is the fibrous variety of serpentine known as chrysotile. Both fibrous amphibole and chrysotile possess qualities which peculiarly fit these minerals for use in the arts. The term asbestos, meaning noncombustible, thus has come to stand for mineral fiber which is more or less resistant to both heat and acids. Although the chrysotile by reason of its chemical composition may be affected by very high temperature and strong acids to a greater degree than the amphibole, the greater strength and flexibility of the chrysotile fiber makes it the more valuable of the two. Thus while mineralogically the amphibole variety is the true asbestos, the chrysotile is the standard asbestos of the trade.

The characteristics by which the two kinds of asbestos may be best distinguished are the yellow-green color and oily or greasy luster of the chrysotile and the unctuous feel of its soft, fluffy fiber as contrasted with the white, gray, green, or brown color and harsher surface of the amphibole fibers. Prof. George P. Merrill has called attention to the angular cross section of the individual fibers in the case of the amphibole asbestos, and the rounded or flattened outline of the silky fibers of chrysotile. The chief chemical difference between the several varieties of asbestos, all of which are silicates, is the presence of water as a more important constituent in the chrysotile. By excessive heating the chrysotile may be made to lose this hydrous condition and then the fibers lack somewhat their silky and elastic character.

OCCURRENCE.

The amphibole asbestos occurs in association with the older eruptive and metamorphic rocks. Occurrences have been reported from most of the Eastern States where there are areas of these rocks, especially Georgia, North Carolina, Virginia, and Connecticut. Georgia and Virginia are the only Eastern States where asbestos of this type is produced at present. Few accurate observations as to the exact nature of these deposits have been recorded.

The chrysotile asbestos has been studied more carefully and earlier volumes of Mineral Resources have contained full descriptions of the Vermont, Arizona, and other occurrences. This variety is always found associated with serpentine derived from the alteration of eruptive peridotite, pyroxenite, or other basic rock. It has been reported as occurring in commercial quantities in Massachusetts, Vermont, North Carolina, Wyoming, Arizona, Washington, Oregon, and California. The largest production is in the eastern townships of Quebec, and an exhaustive report by Mr. Fritz Cirkel on this most productive asbestos region in the world has been recently issued by the mines branch of Canada.[a] In both the Quebec and Vermont localities the chrysotile forms irregular veins in the serpentine rock. These thin veins divide and coalesce, penetrating the massive serpentine in a complex manner. The accepted view is that veins of this character represent shrinkage cracks due to partial dehydration with loss of silica, a process possibly facilitated by the proximity of igneous intrusions, as suggested by Cirkel.

In view of what is known concerning the origin of the two kinds of asbestos, Merrill makes the following pertinent suggestions regarding prospecting for asbestos: "The amphibole variety is to be sought only in regions of crystalline siliceous rocks that have been subjected to more or less movement, such as is incident to folding and faulting. The serpentine variety, on the other hand, is to be sought wherever serpentinous rocks occur and most hopefully where the same have been intruded by igneous dikes."[b]

USES.

The varied uses which have already been made of asbestos serve to explain the active demand for this material. New applications of asbestos products in the arts continue to be made, so that there is every promise of an increasing demand. The amphibole variety is chiefly used in the manufacture of boiler lagging, steam-pipe covering, and insulating cements for general use. The best grade of chrysotile fiber is spun into thread, yarn, and rope, and woven into cloth. The yarn is largely used for packings and the cloth for theater curtains, while fabrics containing asbestos woven with other fibers are made into various household articles where heat insulation is desired rather than fireproof qualities.

The severe demands of improved construction in electric railways have opened up a new field for asbestos products. The need of an insulating material less brittle than glass or porcelain and more durable than rubber has led to the adoption of new compositions which have asbestos as a base and thus possess tensile strength and heat-resisting properties. The increasing use that will be made of such innovations in electrical construction indicates most clearly the extent of future demand for asbestos. A single item like that of arc deflectors, a dozen or more of which are required in every electric motor controller, is sufficient to suggest the universal application of many of the articles largely composed of asbestos.

In planning for the installation of the underground electric railroad in New York City the engineers appreciated the necessity of a fireproof insulating material to protect the underflooring of the subway cars. An asbestos fireproof lumber, termed Transite, was devised and adopted for use not only on the underbody of the cars, but also as roof and side sheathing. The use of fireproof lumber of this type is rapidly increasing, and this material has been largely used in the construction of small stations on a Chicago electric road. A severe test of the fireproof properties of the asbestos lumber was furnished by its use in a fire scene at Coney Island: A structure built entirely of the fireproof lumber on iron supports was many times daily completely enveloped in flames which were then extinguished by streams of water from a fire engine. The conditions were extreme, both in the intensity of the heat and the repetition of the test, but at the end of a season of three months the lumber was found to be in excellent condition.

Other asbestos products in common use are paper and gauze for insulation of electric wires, millboard and asbestos felt for general fireproofing and for moistening pads, gloves for workmen in roller mills and glassworks, hose for carrying hot liquid or gases, and roofing and paint for use where both permanency and fire-resisting qualities are desired.

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[a] Cirkel, F., Asbestos; Mines Branch, Dept. of Interior, Canada, 1905.
[b] Min. World, March 24, 1906.

PRODUCTION.

The output of asbestos in the United States for 1905 was 3,109 short tons, valued at $42,975. This exceeds the production of any previous year, both in tonnage and value, and represents an increase of more than 100 per cent in quantity and of almost 67 per cent in value over the 1904 output. Georgia, Virginia, and Massachusetts contributed 2,995 tons, valued at $38,360, to this total, and the remaining 114 tons, with a value of $4,615, came from California, Michigan, Wyoming, and Arizona.

This increase is due in part to new producers, but more largely to the greater output of the Georgia and Virginia operators. The asbestos from these two States constitutes two-thirds of the total domestic production, and is wholly of the amphibole variety and much of it of a low grade. This will serve to explain the decrease in value per ton, the 1905 average value being $13.82, as opposed to $17.40 in 1904. There was, however, a slight increase in the production of the chrysotile variety, which commands better prices.

The increase in production in the Georgia and Virginia mines is promising and indicates that the manufacturers can use amphibole asbestos to advantage in certain products. Mines in Baraga County, Mich., and Placer County, Cal., are new producers, but of the nature of this product little is known. In California the asbestos is associated with the basic igneous rocks of Jurassic or post-Jurassic age. The asbestos mine in the Grand Canyon, Arizona, produced a small quantity of chrysotile. This deposit was fully described by Dr. J. H. Pratt in the report for 1904, and the fine quality of the fiber as well as the exceptional regularity of the seams were stated as favoring the operation of the deposit.

The chrysotile asbestos localities in Vermont, which were the scene of considerable activity several years ago, have been largely abandoned. Although these deposits probably belong to the same belt as the valuable mines in Canada, the asbestos has disappointed those who sought to develop mines both in the quality and the quantity of the mineral present.

Wyoming has entered the list of producing States, a small quantity of asbestos being reported from Natrona County. Several companies are engaged in development work in this region. Specimens of asbestos from the Casper Mountains have been known for some years, and the samples recently submitted to asbestos manufacturers have been pronounced of excellent quality. The asbestos is of the chrysotile variety, and the fine silky fiber in the specimens exhibited is of good length. As reported, the chrysotile occurs in a large serpentine dike which has been traced and prospected for several miles. The determining factors in the development of the Wyoming deposits will be the quantity of fiber present possessing the quality of the samples submitted and the percentage of asbestos in the serpentine rocks. The distance of this locality from the nearest market is another consideration of importance.

The following table includes the statistics of asbestos produced in the United States and of asbestos imported into this country since 1890. Both the quantity and the value of the United States product are shown, while the value only of the imports is given, the distinction, however, between the manufactured and the unmanufactured asbestos being indicated.

Annual production and annual value of imports of asbestos in the United States, 1890–1905.

Production.			Imports.			
Year.	Quantity.	Value.	Year.	Unmanufactured.	Manufactured.	Total.
	Short tons.					
1890	71	$4,560	1890	$252,557	$5,342	$257,899
1891	66	3,960	1891	353,589	4,872	358,461
1892	104	6,416	1892	262,433	7,209	269,642
1893	50	2,500	1893	175,602	9,403	185,005
1894	325	4,463	1894	240,029	15,989	256,018
1895	795	13,525	1895	225,147	19,731	244,878
1896	504	6,100	1896	229,084	5,773	234,857
1897	580	6,450	1897	263,640	4,624	268,264
1898	605	10,300	1898	287,636	12,897	300,533
1899	681	11,740	1899	303,119	8,949	312,068
1900	1,054	16,310	1900	331,796	24,155	355,951
1901	747	13,498	1901	667,087	24,741	691,828
1902	1,005	16,200	1902	729,421	33,011	762,432
1903	887	16,760	1903	657,269	32,058	689,327
1904	1,480	25,740	1904	700,572	51,290	751,862
1905	3,109	42,975	1905	776,362	70,117	846,479

It will be noticed in this table that the imports have increased, as well as the domestic production. The increase in value of the asbestos consumed in the United States amounts to over $100,000, or nearly 15 per cent in excess of the consumption of 1904. This may be taken as a fair index of the increasing demand for asbestos.

The most of the asbestos imported into this country is produced in Canada, this market taking approximately two-thirds of the Canadian product. In the past decade the production in Canada has shown an almost constant increase—from a tonnage of 12,250 in 1896 to 50,670 in 1905, with values of $429,856 and $1,486,359, respectively. Italy, Russia, Australia, and South Africa are the other principal countries producing asbestos, but as all of these purchase Canadian asbestos, the likelihood of much competition with Canada is not apparent. New finds of asbestos in the eastern Transvaal and in Natal have been reported recently.

PRICES.

The average value of the United States product in 1905 is given above as less than $14. This represents a range in reported selling prices from $5 to over $100. The average price is practically that of the better grade of amphibole asbestos. In 1905 the average value of the Canadian product was over $29, showing the greater value of the chrysotile fiber. The prices for the different grades of asbestos are reported by Cirkel[a] as ranging from $175 or $200 per ton for No. 1 crude, the best grade, to $20 or $25 for the short and broken fiber used for paper stock. The best grade of long fiber suitable for spinning sells for $75 to $80 per ton and the second grade for $50. These prices afford data for a proper estimate of the value of any asbestos deposit, but even more important is the determination of the percentage of different grades of asbestos present in the rock as mined.

Since this estimate of the yield of asbestos rock is so essential in the consideration of the development of an asbestos deposit, some general statements of Cirkel[b] regarding the Canadian mines are cited here. He states that on an average from 30 to 60 per cent of all the rock mined is suitable for milling. In the majority of the mills

[a] Cirkel, F., Asbestos; Mines Branch, Dept. of Interior, Canada, 1905, p. 82.
[b] Op. cit., pp. 78–81.

an extraction of fiber amounting to from 6 to 10 per cent of the milling rock is effected, and considerably less than one-half of this product will be fiber of spinning grades. The quantity of the higher grade crude asbestos secured by hand cobbing in the richest mines is from 1 to 2 per cent, although one or two mines produce a somewhat higher percentage. In a typical mine the asbestos produced amounted to 6 per cent of the rock mined at a cost of over $17 per ton of product for labor, power, and supplies.

The conditions of the asbestos mining industry in Canada control in a way the development of asbestos in the United States. The proximity of the Quebec deposits to the principal markets and the investment of American capital in some of these mines will cause the Canadian product largely to control the price until asbestos deposits are found elsewhere which are comparable in grade and extent.

ASPHALTUM AND BITUMINOUS ROCK.

By Edmund Otis Hovey.

INTRODUCTION.

The mineral species comprised in this report include not only asphaltum proper, but also the other hydrocarbon compounds—ozocerite, wurtzilite, grahamite, and gilsonite (uintahite), together with some less well known forms produced within the United States in commercial quantities. The names employed for the different species are those which have been used by the producers and are what obtain in the trade. The oil-asphaltum made at the refineries of California is likewise included in the tables.

OCCURRENCE.[a]

The hydrocarbons occur in nature in many forms and in all conditions from viscous to solid. One kind or another is found in or associated with the rocks of every geological age from the Lower Silurian to the Pleistocene. Asphaltic deposits usually are found as impregnated beds intercalated among strata of sedimentary origin or as limestone containing fossils or cavities filled with bituminous matter. As a result of local conditions the harder hydrocarbons, like albertite, gilsonite, wurtzilite, and grahamite, are found filling vertical fissures, but ordinarily the bitumen (or asphalt) bearing bed is capped by a bed which has proved impervious to the liquid, which has originated probably, in part at least, in some lower stratum and has merely concentrated in the position where now found.

The most valuable members of the series under consideration are ozocerite, wurzilite, grahamite, and gilsonite. With the exception of grahamite, these occur in commercially important quantities, as far as yet reported, only in the State of Utah. They are prized for the manufacture of certain varnishes and for the insulation of electric wires.

The bituminous sandstones of California are well developed in the vicinity of Santa Cruz. They are, in fact, beach or marine sands heavily impregnated and loosely cemented together by the asphaltic residue of a heavy oil similar to that which is raised from submerged beach sands at Summerland and elsewhere in California. The hard Ventura County asphalts show a more advanced stage of the process which has gone on in the beds near Santa Cruz. The beds containing these hard and soft asphalts have been determined to be of Tertiary age.

The oil-asphaltum produced by the refineries from California crude oils is the result of doing artificially what has been done slowly by nature at several points in the State. The manner of manufacture was described at length in the report upon the production of asphaltum and bituminous rock in 1904. The process consists in

[a] For detailed descriptions of the various 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.

careful and comparatively slow distillation of crude oil at uniform and definite temperatures. The value of the product depends upon the skill and care of the refiner. Several grades, varying from a highly viscous liquid to a hard, brittle solid at ordinary temperatures, are made, which are adapted to the uses to which the product is to be put.

USES.

The coarser and cheaper forms of asphaltic substances are used extensively in the manufacture of roofing and paving materials and for waterproof paint on wood, iron, and stone work. The demands of the eastern markets are supplied for the most part from Trinidad, Venezuela, and Sicily, but the California oil-asphaltum has been used to some extent for street pavements and other purposes in New York and other eastern cities. Gilsonite, or uintahite, is a very pure form of hard asphaltum, which is separated and sold in two grades. The best grade is used for making varnish for ironwork and for baking japans, and similar purposes. Second-grade gilsonite is used as a cement in making pavements. Wurtzilite is similar to gilsonite (uintahite) in appearance and occurrence. It is refined and used for marine and iron paints and insulation, and as a substitute for rubber in certain compounds.

Ozocerite is a natural paraffin, and is used for making shoe and leather polish, sealing wax, pencils, rubber adulterant, candles, and pomades, and for insulating electric wires.

High-grade black Brunswick varnish is made from "manjak," which is a form of asphaltum found on the island of Barbados and elsewhere in the West Indies.

California oil-asphaltum finds wide use throughout California and the West for making street pavements, as roofing cements, for waterproofing and preservative preparations, and as marine and iron paints. Being a pure asphaltum, this material can be mixed in any desired proportions with gravel, crushed rock, and other paving materials.

During the past year considerable quantities of a thick asphaltic oil or fluid asphaltum, known as "road oil," have been produced at the California refineries and sold for use in giving a firm, dustless surface to ordinary dirt roads. This manufacture has developed from the common practice of sprinkling crude oil on the roads to keep down the dust, and it bids fair to grow into a large industry. In this report road oil, as far as reported, is included under oil asphaltum.

Preparations have been made for the manufacture on a large scale of briquettes for fuel from California peat mixed with oil asphaltum. Extensive experimentation has been carried on, and the practicability of the plan is said to be assured. Sample briquettes of this mixture were exhibited in considerable quantity in the California building at the Lewis and Clark Exposition at Portland, Oreg. The asphalt-peat briquettes are said to show high calorific values, though they burn with a great deal of smoke.

Bituminous sandstones and limestones are used either in their natural state or with varying admixtures of gravel or broken rock for paving streets and roads. An asphaltic cementing material, known to the trade as "mastic," is made from the bituminous limestone by a process of refining.

PRODUCTION.

The following table shows the annual production of asphaltum and bituminous rock in the United States from 1882 to 1905, inclusive. 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:

Production of asphaltum and bituminous rock, 1882–1905.

[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	108,572	879,836
1893	47,779	372,232	1905	115,267	758,153

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, 1902–1905.

[Short tons.]

Variety.	1902.		1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Bituminous sandstone	57,837	$156,993	38,633	$118,001	46,641	$138,465	39,273	$94,972
Bituminous limestone	2,869	19,817	2,520	8,800	1,798	4,495	6,029	42,000
Mastic			961	11,532	1,200	10,800	2,200	22,000
Hard and refined, or gum	22,321	264,817	12,896	343,799	6,637	141,446	3,036	41,438
Liquid, or maltha	1,605	20,172	58	1,150	3,363	36,320	3,139	34,292
Wurtzilite [a]					550	50,000	500	44,000
Gilsonite					2,978	14,175	10,916	47,040
Grahamite					1,000	25,000		
Ozocerite							5	1,500
Oil asphaltum	20,826	303,249	46,187	522,164	44,405	459,135	50,169	430,911
Total	105,458	765,048	101,255	1,005,446	108,572	879,836	115,267	758,153

[a] Erroneously entered as "elatesite" (trade name) in the report for 1904. Prior to 1904 included under "Hard and refined, or gum."

Distribution of production of asphaltum in 1905, by States.

[Short tons.]

Variety.	California.		Kentucky.		Indian Territory.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Bituminous sandstone	36,368	$86,302	605	$2,420	1,300	$3,250
Bituminous limestone			6,029	42,000		
Mastic			2,200	22,000		
Hard, or gum	1,400	16,898			1,636	24,540
Liquid, or maltha	3,139	34,292				
Oil asphaltum	50,169	430,911				
Total	91,076	568,403	8,834	66,420	2,936	27,790

Distribution of production of asphaltum in 1905, by States—Continued.

Variety.	Arkansas.		Utah.	
	Quantity.	Value.	Quantity.	Value.
Bituminous sandstone	1,000	$3,000		
Wurtzilite			500	$44,000
Gilsonite			10,916	47,040
Ozocerite			5	1,500
Total	1,000	3,000	11,421	92,540

From the foregoing table it will be seen that the output of bituminous sandstone decreased from 46,641 short tons, valued at $138,465, in 1904 to 39,273 short tons, valued at $94,972, in 1905. This was a decrease of 15.8 per cent in quantity, while the average returns decreased from $2.97 per short ton in 1904 to $2.42 in 1905. More than 90 per cent of the bituminous sandstone produced in the United States is quarried in California, and the decrease in production and value was probably due to the keen competition of the oil asphaltum of the same State. A new use for the hard bituminous sandstone of Kentucky has been devised in the spreading of the ground rock in a crude state, instead of screenings, on top of a macadam bottom for the production of a "dustless, mudless, and noiseless roadway."

The production of bituminous limestone, which is practically confined to the State of Kentucky, increased from 1,798 short tons ($4,495) in 1904 to 6,029 short tons ($42,000) in 1905. The marked increase in value from $2.50 per short ton in 1904 to $6.97 per short ton in 1905 has not been explained. The production of mastic from Kentucky bituminous sandstone increased from 1,200 short tons ($10,800) in 1904 to 2,200 short tons ($22,000) in 1905, with an increase in average reported value from $9 to $10 per short ton.

Hard and refined, or gum, asphaltum decreased in production from 6,637 short tons, valued at $141,446, in 1904 to 3,036 short tons, valued at $41,438, in 1905. The decrease in average value per short ton is very marked, being from $21.31 in 1904 to $13.65 in 1905. During 1905 the hard natural asphalt of California brought $12.07 per short ton at the mines, while that of the Indian Territory brought $15. The more valuable grahamite, important veins of which are known in the Indian Territory, was not produced at all in 1905, on account of litigation over the ownership of the property.

The production of natural liquid asphaltum, or maltha, which is confined to California, decreased from 3,363 short tons, valued at $36,320, in 1904 to 3,139 short tons, valued at $34,292, in 1905.

The production of wurtzilite decreased slightly from 550 short tons, valued at $50,000, in 1904 to 500 short tons, valued at $44,000, in 1905, a decrease in average value from $90.91 per short ton in 1904 to $88 per short ton in 1905.

The production of gilsonite increased enormously from 2,978 short tons in 1904 to 10,916 short tons in 1905. The value increased from $14,175 in 1904 to $47,040 in 1905, but the average price per short ton decreased from $4.76 in 1904 to $4.31 in 1905.

The production of oil asphaltum has increased from 44,405 short tons, valued at $459,135, to 50,169 short tons, valued at $430,911, but the average value decreased from $10.34 per short ton in 1904 to $8.59 per short ton in 1905. If, however, the 1,300 short tons of road oil (which is a liquid oil asphaltum), valued at $1,495, be eliminated from the oil asphaltum there will remain 48,869 short tons of hard or "D" grade oil asphaltum, valued at $429,416, giving an average value of $8.78 per short ton. The production of oil asphaltum is an industry peculiar to California, and most of the material is made as a by-product in the distilling of lubricating and illuminating oils and lighter products from crude petroleum of asphaltic base. Such oil asphaltum could be manufactured in California in quantities far greater than are required to fill the needs of the whole United States, and the industry is now suffering from acute overproduction. The price of crude oil acceptable to the refiner of asphaltum has, generally speaking, been about 33 per cent less than it was in 1904, but even with this advantage the oil-asphaltum producer has been barely able to meet expenses, and in many cases the asphaltum has been sold for less than the actual cost of manufacture. Rates as low as $6 per ton free on board at the refinery were reported as the average value of the entire production of some refineries for the year.

Expert chemists state that the refiners are handicapped by the absence of a process of manufacture which will economically produce an asphaltum free from carbenes (deleterious products of the cracking process which goes on in the stills during the distillation of the heavier oils), with a uniform and suitable penetration and possessing stability on heating. Another obstacle to the trade is the high price of containing packages. No cheap and satisfactory substitute for the wooden-stave barrel has yet been found for asphalt. Barrels of about 480 pounds capacity cost 63 cents or more each delivered at the refineries and are an expensive container for a comparatively low-priced material.

As has been already noted, the California refineries have begun the manufacture on a large scale of a liquid asphaltum from certain oils of asphaltic base. This is known to the trade as the "L" grade asphalt and is about the consistency of thin molasses at ordinary temperatures. It is used, to some extent, as a solvent for the hard asphalts, but more particularly, and on a larger scale, for direct application to roads at a temperature of about 100° F. This material brings a much lower price per ton than the hard grades of oil asphaltum, but there is great saving in the item of cooperage, since the "L," or maltha grade, also known as "road oil," is delivered by the refineries into tank cars and is pumped from the tank cars into tank wagons for spreading over the roads.

EXPORTS.

During the fiscal year ending June 30, 1905, asphaltum and manufactures of asphaltic material to the total value of $291,120 were exported from the United States to other countries. The most important receivers of these products were, in the order named: Brazil, United Kingdom, Dominion of Canada, Germany, Chile, Mexico, and Argentina. The chief features of the trade were the opening of important markets in Mexico and the three South American countries named, a marked increase of exports to the United Kingdom, and a decrease, as compared with 1904, of more than 36 per cent in the value of exports to the Dominion of Canada.

The total value of the exports for the fiscal year ending June 30, 1904, amounted to $160,186.

IMPORTS.

The following table shows the imports of crude asphaltum by calendar years from 1902 to 1905, inclusive:

Crude asphaltum imported for immediate consumption into the United States, 1902–1905.

Year.	Quantity.	Value.
	Short tons.	
1902	[a] 164,409	$489,570
1903	[b] 203,368	593,346
1904	133,941	590,890
1905	[c] 100,596	479,296

[a] Includes 8,108 short tons "dried or advanced," valued at $62,561.
[b] Includes 17,200 short tons "dried or advanced," valued at $83,591.
[c] Includes 9,688 short tons "dried or advanced," valued at $78,639, and 5,895 short tons bituminous limestone, valued at $19,183.

About 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 Italy. Smaller quantities are imported from Switzerland, Germany, France, and Turkey in Asia, with insignificant quantities from the United Kingdom, Colombia, and Austria-Hungary.

The following table shows the imports of asphaltum (crude, dried and advanced, and limestone rock asphalt) for the fiscal years ending June 30, 1903–1905, inclusive:

Imports of asphaltum during the fiscal years ending June 30, 1903, 1904, and 1905, with the countries from which exported.

[Short tons.]

Country.	1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
West Indies:						
British (Trinidad)	144,629	$367,003	123,235	$368,623	98,213	$397,277
Cuba	11,086	48,218	10,633	22,230	13,772	44,529
Venezuela (Bermudez)	18,418	74,874	56,217	217,017	33,461	149,573
Italy	15,444	61,284	3,596	11,581	8,807	28,244
Germany	1,593	9,974	1,711	11,755	417	3,442
Switzerland	495	3,735	464	3,815	1,486	12,986
Mexico	696	2,369	428	2,223	398	4,032
Nova Scotia			146	1,032		
Turkey in Asia	75	5,038	133	2,763	447	6,158
United Kingdom	152	2,885	71	932	74	1,173
British India			55	312		
United States of Colombia	3	106	26	1,456	26	672
Austria-Hungary			2	46	11	99
Turkey in Europe	715	8,917				
France	334	1,462			338	1,983
Netherlands						36
Total	193,640	585,865	196,717	643,785	157,450	650,204

As may be seen from this table, the imports from Trinidad decreased from 123,235 short tons ($368,623) in the fiscal year ending June 30, 1904, to 98,213 short tons ($397,277) in the fiscal year ending June 30, 1905, and the imports from Venezuela decreased from 56,217 short tons in 1904 ($217,017) to 33,461 short tons ($149,573) in 1905. The imports from Cuba show an increase from 10,633 short tons ($22,230) in 1904 to 13,772 short tons ($44,529) in 1905. The imports from Italy increased from 3,596 short tons ($11,581) in 1904 to 8,807 short tons ($28,244) in 1905.

The total importations in the fiscal year ending June 30, 1905, were 157,450 short tons, valued at $650,204, as compared with imports of 196,717 short tons, valued at $643,785, in the fiscal year ending June 30, 1904, a decrease in quantity of 39,267 short tons, but an increase in value of $6,419.

PRODUCTION IN OTHER COUNTRIES.

TRINIDAD.

For about a century the enormous deposits of asphaltum upon the island of Trinidad have been known, and many widely varying accounts thereof have been published. The best scientific description is that of S. F. Peckham, entitled "On the Pitch Lake of Trinidad,"[a] and the commercial aspects of the Trinidad asphalt have been given in detail by W. P. Pierce.[b]

The asphalt of Trinidad is described as occurring in two forms—land pitch and lake pitch—although there seems to be no fundamental difference between the two varieties. The pitch lake is the original source of all the asphaltum which is exploited in the vicinity of the village of La Brea and between the village and the lake, the land pitch being material which has overflowed from the pitch lake through a crevice in its side and has descended the slopes to the sea. The surface of the lake is 138 feet above the sea, its area is about 100 acres, and it is nearly circular in outline. The bed of asphalt forming the lake is from 18 to 78 feet in thickness. The early reports described the material near the middle of the lake as being warm and soft. Now, however, the asphalt is firm enough to support teams at any point for a long enough time to permit of loading. Much water is present in crevices in the asphalt. The lake is thought to occupy the crater of an old mud volcano, and a constant supply of asphaltum is coming into the lake from subterranean sources. Excavations in the lake pitch, and in the land pitch also, fill again with asphaltum in a short time.

The crude asphaltum has the following properties[c]: Specific gravity, 1.28; hardness at 70° F., 2.5 to 3 in Dana's scale; color, brown. Its partial analysis is as follows:

Partial analysis of crude asphaltum.

[H. B. Bowen, analyst.]

Bitumen	39.83
Earthy matter	33.99
Vegetable matter	9.31
Water	16.87
Total	100.00

The earthy matter consists mostly of clay, and the rest is very fine sand.

The refined asphalt has the following properties: Specific gravity, 1.49; hardness at 70° F., 2.5; color, black. Its partial analysis is as follows:

Partial analysis of refined asphalt.

Bitumen	59.86
Earthy matter	35.82
Vegetable matter	4.32
Total	100.00

The exports of asphaltum from the island of Trinidad decreased considerably during 1905, and were the lowest in grand total for any year since 1898. According to the report of the New Trinidad Lake Asphalt Company (Limited), through whose courtesy this statistical information regarding the asphaltum of Trinidad has been received, the total quantity exported of all asphaltum from the island for the year ending January 31, 1906, was 128,685 short tons, as compared with 151,122 short tons in the year ending January 31, 1905.

The decrease of the exports from the island to the United States accounts for most of this decline, the quantity for the year ending January 31, 1906, having been 67,282 short tons, as compared with 95,889 short tons for the year ending January 31, 1905, a decrease of 28,607 short tons. The quantity of lake asphaltum (53,701 short tons) exported to the United States is the smallest reported for fifteen years, and that of land asphaltum (13,581 short tons) is the smallest reported for nine years.

[a] Peckham, S. F., The pitch lake of Trinidad: Am. Jour. Sci., 3d ser., vol. 1, July, 1895, pp. 33-51.
[b] Pierce, W. P., Asphalt of Trinidad: U. S. Monthly Cons. Rpts., No. 145, October, 1892, pp. [illegible]-239.
[c] Greene, F. V., Asphalt and its sources: Trans. Am. Inst. Min. Eng., vol. 17, pp. 363-364.

About 89 per cent of the material exported in 1905 was obtained from the pitch lake, which is under the control of the New Trinidad Lake Asphaltum Company (Limited) under a long-term lease. The lake constantly receives fresh supplies of asphaltum from subterranean sources, but of late years the quantity thus coming in has been less than that which has been removed, so that the level of the lake has been slowly lowered. More than 2,533,440 short tons of asphaltum have been removed from the pitch lake and exported to foreign countries since the records have been kept.

Exports of pitch-lake asphaltum from Trinidad, 1904–1905.

[Short tons.]

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.	
1904 [a]	66,444	2,990	70,597	32,446	13,719	52,972	....	1,098	1,522	125,091
1905 [b]	49,011	3,377	53,701	31,632	15,379	54,640	....	4,248	5,900	114,241

[a] Year ending January 31, 1905. [b] Year ending January 31, 1906.

Exports of land asphaltum from Trinidad, 1904–1905.

[Short tons.]

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.	
1904 [a]	25,124	112	25,292	....	112	168	403	112	571	26,031
1905 [b]	13,581	....	13,581	577	....	577	....	190	286	14,444

[a] Year ending January 31, 1905. [b] Year ending January 31, 1906.

Total exports of all asphaltum from Trinidad, 1904–1905.

[Short tons.]

Year.	To United States.			To Europe.			To other countries.			Grand total.
	Lake.	Land.	Total.	Lake.	Land.	Total.	Lake.	Land.	Total.	
1904 [a]	70,597	25,292	95,889	52,972	168	53,140	1,522	571	2,093	151,122
1905 [b]	53,701	13,581	67,282	54,640	577	55,217	5,900	286	6,186	128,685

[a] Year ending January 31, 1905. [b] Year ending January 31, 1906.

BARBADOS.

Manjak is the local name applied to the glance pitch which occurs commercially, so far as known, upon the island of Barbados alone. Manjak is a variety of asphaltum which somewhat resembles gilsonite (uintahite) in appearance, but it is more brittle and is very friable. The material is reported as occurring in veins which vary in width from one-fourth of an inch to 30 feet. The veins have a general north-northeast strike and varying dip. The country rock is an argillite or shale which, in places, is so saturated with bituminous matter that petroleum has been produced by destructive distillation at the rate of 37 gallons per ton of shale. Manjak is a very pure hydrocarbon compound and is used in the manufacture of high-grade waterproofing, varnishes, and insulating compounds.

The annual production of manjak in Barbados for the last five years has been as follows: 1901, 1,168 short tons; 1902, 1,033 short tons; 1903, 728 short tons; 1904, 707 short tons; and 1905, 725 short tons. As reported by the American consul at Borbados, the price free on board cars given by the shippers is from $30 to $54 per short ton, according to quality. The official average value is stated to be $42 per ton. The entire output of the mines is exported, there being no local consumption of manjak.

VENEZUELA.

The production of asphaltum from Bermudez Lake in Venezuela, which fell off greatly during 1902 and 1903 on account of litigation between the two American companies claiming the right to work the deposits, attained unusual proportions in 1904 after the settlement of the legal complications between the companies. The imports into the United States fell off from 56,217 short tons, valued at $217,017, in the fiscal year ending June 30, 1904, to 33,461 tons, valued at $149,573, in the fiscal year ending June 30, 1905. The returns, however, show a slight increase in the average value per ton both of the crude and of the dried or advanced.

CUBA.

Much asphaltum is reported as occurring at several places in the island of Cuba, and exploitation of the material has expanded greatly during recent years. The reports indicate that more than three-fourths of the asphaltum exported from Cub. is 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 1901 to 1904, inclusive:

Production of asphaltum in principal producing countries, 1901–1904.

[Short tons.]

Year.	United States.		Trinidad.		Germany.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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	204,880	943,302	96,401	198,940
1904	[a] 64,167	420,701	152,392	727,552	101,121	212,058

Year.	France.		Italy.		Spain.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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
1904	250,222	289,415	123,347	307,985	4,146	7,259

Year.	Austria-Hungary.		Russia.		Venezuela.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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	([b])	....	[c] 16,057	$286,113
1904	4,029	59,386	([b])	....	[c] 14,910	262,809

[a] Oil asphaltum is excluded from this table of crude production, since it is a product of distillation.
[b] Statistics not yet available.
[c] Exports.

BAUXITE AND ALUMINUM.

BAUXITE.

PRODUCTION.

The production of bauxite in the United States in 1905 amounted to 48,129 long tons, valued at $240,292, as compared with 47,661 long tons, valued at $235,704, in 1904. As appears from the following table, the production of bauxite in Alabama and Georgia seems to be on the decline, while the output in Arkansas is increasing very rapidly. Both the Georgia-Alabama[a] and the Arkansas[b] bauxite regions have been described by Dr. C. Willard Hayes, of the United States Geological Survey.

The following table gives the production and value of bauxite from 1889 to 1905, inclusive:

Production of bauxite in the United States, 1889–1905, 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>
<tr><td>1905</td><td colspan="2">15,173</td><td>32,956</td><td>48,129</td><td>240,292</td></tr>
</table>

CONSUMPTION.

In order to show the annual consumption of bauxite and its value in the United States during the last eight years, the following table has been compiled, which includes the annual production, imports, exports, and consumption, together with the value of each, respectively:

[a] Sixteenth Ann. Rept. U. S. Geol. Survey, pt. 3, 1895, pp. 547–597.
[b] Twenty-first Ann. Rept. U. S. Geol. Survey, pt. 3, 1901, pp. 435–472.

Production, imports, exports, and consumption of bauxite in United States, 1898–1905.

[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			43,112	175,875
1903	48,087	171,306	14,889	49,684			62,976	220,990
1904	47,661	235,704	15,374	49,257			63,035	285,961
1905	48,129	240,292	11,726	46,517			59,855	286,809

WORLD'S PRODUCTION.

The following table shows the world's production of bauxite in 1903 and 1904:

World's production of bauxite, 1903–4.

[Long tons.]

Country.	1903.		1904.	
	Quantity.	Value.	Quantity.	Value.
United States	48,087	$171,306	47,661	$235,704
France	131,781	226,798	74,449	131,229
United Kingdom	6,128	7,368	8,700	8,340
Total	185,996	405,472	130,810	375,273

ALUMINUM.

PRODUCTION.

The production of aluminum in the United States has increased nearly tenfold in as many years. Two reasons would explain this phenomenal growth—economic production, which has initiated lower prices, and increased consumption, especially in the electrical industry.

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:

Production of aluminum in the United States, 1883–1905.

[Pounds.]

Year.	Quantity.	Year.	Quantity.
1883	83	1896	1,300,000
1884	150	1897	4,000,000
1885	283	1898	5,200,000
1886	3,000	1899	6,500,000
1887	18,000	1900	7,150,000
1888	19,000	1901	7,150,000
1889	47,468	1902	7,300,000
1890	61,281	1903	7,500,000
1891	150,000	1904	[a] 8,600,000
1892	259,885	1905	[a] 11,347,000
1893	333,629		
1894	550,000	Total	68,409,779
1895	920,000		

[a] Consumption.

Aluminum and manufactures of aluminum of domestic production were exported valued at $157 187 in 1903, at $166,876 in 1904, and at $290,777 in 1905.

IMPORTS.

In the following table are given the quantities and values of crude and manufactured aluminum imported from 1891 to 1903:

Imports of crude and manufactured aluminum, 1891–1903.

Calendar year.	Crude.		Leaf.		Plates, sheets, bars, and rods.		Manufactures.	Total value.
	Quantity.	Value.	Packs of 100.	Value.	Quantity.	Value.		
	Pounds.				*Pounds.*			
1891	3,922	$6,266	10,033	$1,135			$1,161	$8,562
1892	43	51	11,540	1,202			1,036	2,289
1893	7,816	4,683	18,700	1,903			1,679	8,265
1894	5,306	2,514	10,780	1,210			386	4,110
1895	25,294	7,814	6,610	646			1,841	10,301
1896	698	591	4,657	523			2,365	3,479
1897	1,822	1,082	4,260	368	4,424	$3,058	221	4,729
1898	60	30	2,000	174	18,442	8,991	4,675	13,870
1899	53,622	9,425	693	112	4,254	2,413	5,303	17,253
1900	256,559	44,455	1,103	102	4,264	2,776	3,111	50,444
1901	564,803	104,168			7,764	5,319	261	109,748
1902	745,217	215,032	210	32	4,652	2,548	1,239	218,851
1903	498,655	139,298			4,276	2,818	1,355	143,471

ALUMINUM SALTS.

The following table shows the production and imports of alum and aluminum sulphate for the years 1898 to 1905:

Production and imports of alum and aluminum sulphate into the United States, 1898–1905.

[Short tons.]

Year.	Production.						Imports.[a]		
	Alum.			Aluminum sulphate.			Quantity.[b]	Value.	Price 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
1905	10,114	289,716	28.65	93,917	1,660,515	17.67	1,274	24,804	19.47

[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); in 1904, 18 tons ($2,875); and in 1905, 8 tons ($1,438).

USEFUL MINERALS IN THE BLACK SANDS OF THE PACIFIC SLOPE.

By David T. Day and R. H. Richards.

INTRODUCTION.

In this report the expression "black sands" is used to embrace the residual sands left in concentrating placer gravels. Usually they denote the heavy materials left in the sluice boxes in placer mining, but they include also both the black sands left by the concentrating action of waves and the natural concentration products of stream action. They consist principally of minerals with a specific gravity above 3; and, although the expression "heavy sands" would be more appropriate, they are as a rule darker in color than the gravel from which they are obtained, and the expression "black sands" has become general.

On account of the increasing scarcity of the world's supply of platinum, Congress, in the sundry civil act approved March 3, 1905, directed the United States Geological Survey to include in the report on the mineral resources of the United States an investigation of the useful minerals contained in the black sands of the Pacific slope, and this instruction was subsequently enlarged to embrace the United States. In the beginning of the investigation a circular letter was sent to all the placer miners of the United States whose addresses were known, some 8,000 in all, authorizing them to send in samples of the black sands obtained by them up to 4 pounds for each sample. The examination of these samples, partly in Boston, Mass., and partly in Portland, Oreg., showed that the following minerals, in the order named, are most commonly found in these sands: Magnetite, gold, ilmenite, garnet, zircon, hematite, chromite, platinum, iridosmium, mercury, amalgam, olivine, and iron silicates, pyrite, monazite, copper, cinnabar, cassiterite, and corundum. Other heavy minerals are only exceptionally found.

Platinum.—Platinum was found in 120 localities. The investigation showed that the largest field of platinum, and the most profitable field for commercial exploitation, is comprised in Coos, Jackson, Curry, and Josephine counties, Oreg., and in Del Norte, Siskiyou, Humboldt, and Trinity counties, Cal. Outside of this region platinum is also found to a notable extent in Plumas and Butte counties, Cal., and, although the proportion of platinum per cubic yard of gravel is not so great, the large dredging operations in Butte County make this an important locality. Platinum was also found occasionally on the Snake and the Columbia rivers and on various beaches of the Washington coast. It was found in place in chromite near Anacortes, Wash., as well as at the previously known locality, the Rambler mine, in Albany County, Wyo.

Investigation of concentration methods.—In order to determine what minerals could be included under the title "useful minerals" in these black sands, it was necessary to determine how readily they could be separated from one another by various methods of concentration. As a result it was found that with careful sizing it is possible to separate gold and platinum from these sands with comparative ease and with small expense by use of concentrating machines of the shaking table class, and that partial separation of various other minerals can be made at the same time, so as to render available for the market at a low cost monazite, zircon, ilmenite, chromite, garnet, and cassiterite.

Magnetite.—It was found that the magnetite contained in the black sands of the Pacific slope constitutes a greater supply of useful iron ore than any other available source known on the Pacific slope. This magnetite usually contains from 5 to 10 per cent of titanium. It was found that this titanium offered no obstacle to the production of high-grade cast iron in the electric furnace, and that in a modification of this electric furnace this cast iron could even be decarburized to a very soft iron of high quality. Facilities were not at hand for smelting this iron ore in an ordinary blast furnace.

PREVIOUS INVESTIGATIONS OF BLACK SAND.

Prof. W. P. Blake[a] investigated the black sands of the Pacific coast in 1853, and found in them platinum and iridosmium to the extent of 10 to 30 per cent of the gold. He also noted that the platinum could frequently be lifted by a magnet. His experience showed that the farther north he went on the California and Oregon coast the greater the proportion of platinum to gold. Subsequent investigation has proved this to be true for as far north as Coos County, but it is not true farther north. In fact the Alaskan coast has so far proved barren in platinum; but Blake's statement was accepted as a rule, with the result of attracting much fruitless exploration for platinum beyond the regions to which his investigations were limited. In 1873 Prof. B. Silliman[b] made an examination of the heavy residual sands obtained in placer mining at Cherokee, in Butte County, Cal., and showed them to contain, among other minerals: Chromite (chiefly), gold, platinum, iridosmium (more abundant than platinum), magnetite, limonite, zircon, rutile, garnet, and epidote. He also mentions diamond, topaz, and pyrite as includible in the mineralogy of the Cherokee gold washings. In 1894 in the Mining and Scientific Press Mr. J. A. Edman first suggested the use of percussion tables for separating gold and platinum from black sands. He also gave a good description of the mineralogy of these sands.[c]

Since the time of these pioneer investigations the black sands have been a fruitful field of experimentation for a method which would economically extract the gold and the platinum. Unfortunately most of these investigations have been in the direction of some modification of the method of separating sands by running water, after the fashion of sluice mining, and, while many of them have shown much ingenuity, it is a significant fact that the present investigation has discovered only one placer mine in the United States where the action of water on these sands was supplemented by the shaking motion characteristic of the Wilfley and similar tables. As soon as this feature was introduced, the possibility of successful results became evident.

Meanwhile many examinations as to the materials contained in these sands have been made by various authorities, but the examination was usually confined in each case to a particular locality, and no general investigation of this subject was attempted.

PRELIMINARY WORK OF PRESENT INVESTIGATION.

In order to obtain material for preliminary examination a letter, as has already been mentioned, was sent to all of the placer miners whose addresses were available, about 8,000 in number. The resulting samples received at Washington underwent a preliminary examination there and were then sent to the Massachusetts Institute of Technology.

At the outset of the investigation Prof. Robert H. Richards, head of the mining department of the Massachusetts Institute of Technology, was retained to take joint

[a] Gold and platinum of Cape Blanco: Am. Jour. Sci., 2d ser., vol. 18, 1854, p. 156.
[b] Am. Jour. Sci., 3d ser., vol. 6, 1873, p. 132; also, Trans. Am. Inst. Min. Eng., vol. 1, 1873, p. 371.
[c] Notes on gold-bearing black sands of California: Min. and Sci. Press, Nov. 10, 1894.

charge of the investigation, and he immediately elaborated a general scheme for their examination. A corps of assayers, under Mr. Charles R. Locke, determined the gold, platinum, and iridosmium content of the sands, and the material was then turned over to Dr. Charles H. Warren, professor of mineralogy in the Massachusetts Institute of Technology, who, by such classification methods as were available, divided the minerals contained in the sands into groups, and in these groups identified all possible minerals, giving as accurate a statement as was possible of the proportion of each mineral present.

The minerals enumerated within were obtained from the samples by these examinations at Boston, and by a more elaborate system of examinations subsequently carried on at Portland.

The majority of the samples represent waste heavy sands thrown out of the sluice boxes in the clean-ups of placer mines. They are thus concentrates, but concentrates containing the precious metals in such a mixture of other heavy minerals as to make it impracticable for the placer miner to save either gold or platinum by the processes with which he has been familiar.

It was frequently difficult and sometimes impossible to obtain any satisfactory statement as to the degree of concentration of the samples sent in by placer miners. All the available information obtained is given in the "remarks" column of the table. Unsatisfactory as this column is, it is sufficient to show that if the heavy sand which is now going to waste in California and Oregon alone were saved, and that if, in turn, only two-thirds of the platinum shown to be in the samples where the exact proportion of platinum has been determined were saved from those sands, the total production of platinum from these two States would exceed the present consumption of platinum in the United States. This does not include the many specimens where gold and platinum are grouped together. In many samples the sand grains were not individual minerals and could not be separated by mechanical washing. These are included in the table as "unclassified."

FIELD EXAMINATIONS.

Cooperation of transportation companies.—The Southern Pacific Railway system, in generous appreciation of the nature of this work, offered to transport unlimited quantities of sands from any point on that system to Portland, Oreg. Similar aid was given by the Astoria and Columbia River Railroad, between Astoria and Portland; by the Northern Pacific, the Canadian Pacific, the Great Northern Railway, the Burlington system, and the Pacific Coast Steamship Company. This generous aid made it practicable to collect and examine several hundreds of tons of placer sands, frequently in carload lots, and thus to determine on a large scale the efficiency of the various concentrating machines loaned for this purpose.

The collection of these samples was in charge of Prof. J. F. Kemp, of Columbia University, New York, and under his direction Mr. A. H. Gale, of Harvard University, visited Clatsop County, at the mouth of the Columbia River, and examined the sea sands contained within the triangle bounded on the east by the ridge of indurated clay which extends from Tongue Point, east of Astoria on the Columbia River, to Tillamook Head on the Pacific sea beach, on the north by the Columbia River and on the west by the ocean. From this area Mr. Gale selected, as representative of the material a carload from the river beach at Hammond Station, near Fort Stevens, designated in the tables as P 5A, and from farther west a second carload known as P 5B. Another carload was taken from Warrenton, another from Carnahan Station, and another from the beach at Seaside, adjacent to Tillamook Head. The results of the examinations of these are given under Clatsop County in the table of the mineral composition of various black sands. Still another carload was taken by him from the dredge *William M. Ladd,* when dredging in the main river channel near Pillar Rock, above Astoria. In addition to these samples collected by Mr. Gale, the entire beach from Fort Stevens to

Elk Creek beyond Tillamook Head was sampled by Doctor Day and his assistants, with the results given under Clatsop County in the general table referred to. Professor Kemp, together with Mr. Gale, next visited Josephine County, Oreg., and took samples varying from 100 pounds to 1 ton each, and also many smaller samples in the neighborhood of Kerby and Waldo, Josephine County; and they then proceeded to Crescent City, Cal., whence representative samples from the ocean beach were sent in for examination. Professor Kemp then took representative samples at frequent intervals on the Pacific beach northward from Crescent City to Bandon, Oreg.

Mr. Gale went southward from Crescent City, taking samples at Upper and Lower Gold Bluff, Humboldt County, Cal., and then, proceeding from Arcata to various points on the Trinity and the Salmon rivers, he continued through by the trail to Forks of Salmon, and thence on to Butte and Sierra counties, Cal., where a careful reconnaissance of the placer mines was made. Professor Kemp then visited several placer localities in Colorado and finally made a careful examination of the placer gravels in the neighborhood of Tinton, S. Dak.

Mr. Earl Bachert, after acting as assistant to Mr. Gale, visited Bellingham Bay, Washington, and continued to Shishi Beach, near Cape Flattery, and thence sent in large samples of beach sands. Mr. Henry Landis, professor of geology in the University of Washington, visited the ocean beach at Ozette, Wash., and furnished representative samples from that point. Doctor Day collected 1 ton of representative sand from Rennies Island, in Grays Harbor, and a ton of the heavy magnetic sand from Damons Point on the ocean beach. He collected additional representative samples from Oyhut, Cow Island, and Moclips, on the beach north of Grays Harbor. Later in the year a party under the charge of Doctor Day collected ton samples of sand from Sand Island, at the mouth of the Columbia River, and took samples representing all the beaches from Cape Disappointment to Oysterville on the Washington coast. Mr. Bachert collected a carload of sand from Yaquina Beach, near Newport, Oreg., and Mr. Alvin Smith and party collected large samples from the Pacific Ocean beach at the mouth of Alsea River, Oregon.

Mr. W. T. Schaller visited the beaches south from San Francisco to San Luis Obispo, Cal., and sent in small samples for investigation. This was followed by a visit to the elevated beach at Aptos, on Monterey Bay, by Mr. Earl Bachert, where a carload of sand was collected. Another carload, characteristic of the beach, was collected at Ocean Park, near Los Angeles. Doctor Day visited Oroville, Cal., collecting 5 carloads in all of representative tailings from the dredges of Oroville and Marysville.

Mr. Victor C. Heikes collected commercial samples from American Falls, Idaho, and from other points on the Snake River. Mr. H. E. Crain collected ton samples from the Rambler mine, Albany County, Wyo.; from Green River in the same State; from Idaho City and Centerville, Idaho; and from various points in the neighborhood of Lewiston, Idaho.

Mr. L. G. Gillett collected a carload sample from Deer Creek, Montana. Dr. Joseph Hyde Pratt collected a carload of sand, representative of the region where platinum had already been identified, at Miles City, Mont. One ton of heavy sand residues was obtained from Tonopah, Nev. A party under the charge of Mr. L. G. Gillett, and later under the charge of Mr. W. L. Walker, made some 200 excavations on the Snake River between the Minidoka Dam and a point opposite Wapi, Idaho, collecting in all some 4 carloads of sand.

Mr. Walter Harvey Weed collected representative samples from the well-known sand-chrome deposits, from which chrome iron ore was first obtained in the United States, in the neighborhood of Owings Mills and Glyndon, Md. Further samples, characteristic of the Atlantic Ocean beach, at Ocean City, Md., were also examined. Mr. D. B. Sterrett collected pannings from various placer localities in the Balsam Forest district, North Carolina.

In addition to the samples obtained during these field investigations, many samples were contributed by various members of the Geological Survey in the course of the regular field work.

Of the minerals found the following are evidently salable wherever found:

Amalgam.
Cassiterite.
Cinnabar.
Columbite and tantalite.
Corundum (gems).
Gold.
Iridium.
Iridosmium.
Josephinite (alloy of iron and nickel).
Lead (bullets, shot, etc., are usually saved in placer mining and smelted).
Mercury.
Platiniridium.
Palladium (with platinum).
Platinum.
Sperrylite.

With regard to the other minerals, whether they can be classed as useful depends on the cost at which they can be delivered at a point of consumption where a market can be found for them. Thus, as to magnetite, this mineral, which furnishes a fair proportion of the utilized iron ore of the United States, would not be considered as of any value where the production of a region amounted to only a few tons annually; that is, where the ore was not in sufficient quantity to supply the wants of a moderate iron-smelting establishment. Even with the ore in large quantity the cost of transportation to the point of consumption might be so high as to render it useless. Again, the purity of the actual grains of magnetite as affecting its usefulness in making pig iron or steel concerns its definition as a "useful mineral."

In the case of such a mineral as garnet, useful chiefly as abrasive material, the question requiring investigation is as to the physical character of the grains, whether they are sufficiently sharp to serve as a good abrasive.

The purity of the minerals found is of vital importance in determining their usefulness. Thus sand chrome, as formerly obtained on both the Atlantic coast and the Pacific coast, has come into more or less disrepute on account of the grains of other minerals mixed with it. But after ordinary water washing it would manifestly become an extremely useful mineral if practically pure grains of chromite should be separated from all the other minerals, thus producing a higher grade of chromite than any now purchasable. Such chromite must demand a higher price because of the comparatively slight amount of grinding necessary to reduce the already small grains of sand to powder and because also of the increased ease of decomposition to chromate in proportion as the ore is of high grade.

On the west coast of the United States even quartz sand becomes an extremely useful mineral when it is sufficiently separated from others. Thus pure quartz, suitable for refractory linings in the manufacture of steel castings, has frequently reached a value of from $5 to $15 per short ton delivered in Portland, Oreg., and it is now frequently transported from Illinois to the Pacific seacoast. As a rule all of the minerals in the following tables would find some useful application if separated absolutely each from all the others.

These considerations show the great advantage of such determination of the various characteristics of the minerals found as will lead by the most inexpensive means possible to their separation from one another. Thus far practically the only mineral separated from these sands has been gold, and that most imperfectly. The method employed is based on the relative specific gravities of the minerals and on the readiness with which all the minerals, except gold, can be washed away from this metal.

In order to apply various methods of concentration to these sands, a special building was set apart at the Lewis and Clark Exposition, and an invitation was issued to the manufacturers of all concentrating machinery to send full-sized machines to that place for use in determining how these sands could be concentrated, as well as for ordinary exhibition purposes. Those who responded favorably to this invitation are recorded in a later section of the report.

The following tables show the mineral composition of the black sands:

Mineral composition of various black

[Given in pounds per ton, except gold and

Serial number.	Locality.	Magnetite.	Chromite.	Ilmenite.	Garnet.	Hematite.	Olivine.
	ALASKA.						
	Cape Nome district:	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*
P 65	Cape Nome	137		[a]64	755		
R 3653	Do	208		48	1,192	48	
R 3936, No. 4	Santa Rosa claim	80					
R 3936, No. 5	Do						
R 3882, No. 2	Little Creek						
R 3811, No. 1	Portland Bench, Little Creek.	10					
R 3811, No. 2	Do	16					
R 3882, No. 1	East of Portland Bench						
R 3883 No. 1	Portland Bench						
R 3883, No. 2	Do	40					
P 490 through 2 on ½. [b]	Alaska through Seattle	222	10	960			
P 490 through ½	Do	392	92	436			
P 751 A	Klondike, Hunker Creek	1,612		32		96	
P 751 B	Do						
P 754 D	Buck Creek, York tin district.	2					
P 71	Eagle River, Windfall Creek	869	38		717		270
P 109	Yukon Territory, Dominion Creek.	1,088	180		632		
	ARIZONA.						
R 3185, No. 2	Graham County, Morenci	1,168		312		312	
	Maricopa County:						
R 3973	Wickenburg	1,024		320		344	
R 3806	Do	1,440				328	
	Pima County:						
R 3340	Greaterville	950				962	
R 3746	Santa Rita Mountains	1,216		304		304	
R 3063	Pinal County, Tucson	1,320		150		450	
	Yavapai County.						
R 3295	Arizona City	1,560		128			
R 3157	Columbia (near)	960				592	
R 3158	Do	880				656	
R 3415	Black Canyon Creek	1,520			80	350	
R 3428	Skull Valley	1,616			10	330	
R 3678	Walker mining district	1,872					
R 3923	Bridle Creek	960		320		300	
R 3922	Musquette Gulch	720				720	
R 3357	Prescott	1,376		80		160	

[a] Includes rutile.

sands of the United States, by localities.

platinum, which are given in dollars per ton.]

Monazite.	Limonite.	Zircon.	Quartz.	Unclassified.	Gold.	Platinum.	Gold and platinum.	Remarks.
Pounds per ton.	*Pounds per ton.*	*Pounds per ton*	*Pounds per ton.*	*Pounds per ton.*	*Dollars per ton.*	*Dollars per ton.*	*Dollars per ton.*	
...	...	4	905	132	Trace.	...	...	Waste from sluice boxes.
...	...	...	...	504	0.41	...	...	Not concentrated.
...	...	...	...	1,920	46.10	...	...	False bed rock.
...	...	...	...	...	185.84	...	...	Face of drift.
...	...	...	...	...	521.09	...	...	Pyritic concentrates.
...	...	...	300	1,690	2,780.94	...	...	4 inches above bed rock.
...	...	...	...	1,984	203.30	...	...	Sand from shaft.
...	...	...	...	2,000	.83	...	...	2 feet above bed rock.
...	...	...	...	2,000	44.65	...	...	Do.
...	...	...	...	1,960	170.94	...	...	6 inches above bed rock.
...	...	...	...	808	50.85	...	...	Concentrates.
...	...	...	6	1,072	19.84	...	...	Do.
...	...	...	174	58	52.09	...	...	28 pounds pyrite. Concentrates.
...	...	...	...	...	...	...	...	72¼ per cent stream tin. Concentrates.
...	...	...	...	...	.21	...	...	1,432 pounds=cassiterite; 414=hübnerite; 76=wolframite.
...	...	36	70	...	26.22	...	...	Concentration not known.
...	...	83	68	28	411.90	...	...	Concentrated to $\frac{1}{300}$.
...	...	...	...	200	123.61	...	...	From sluice, concentration not known.
...	...	...	256	56	11.99	...	...	Brown sand, concentrated to $\frac{1}{8}$.
...	...	8	...	224	34.73	...	...	Black sand, concentration not known.
...	...	Trace.	...	88	26.87	...	...	From sluice, concentration not known.
...	...	Trace.	...	176	...	...	None.	Concentrated to $\frac{1}{2}$.
...	...	Trace.	...	80	5.20	...	...	Black sand.
...	...	Trace.	...	312	Trace.	...	...	Brown sand from 5 cubic yards.
...	...	...	...	448	174.25	...	...	Black sand, 250 pounds concentrated to 3½ pounds.
...	...	...	216	240	16.33	c1.80	...	Concentrated to 4 pounds from 250 pounds.
Trace.	...	...	80	...	21.50	...	...	Black sand, concentration not known.
...	...	10	...	34	21.91	...	...	Original sand yields $2 to $3 per yard.
...	...	...	...	128	39.62	...	...	1 cubic yard gravel gives 50 pounds of this sand.
...	...	...	400	20	...	...	None.	1 pound to ton of gravel.
...	...	...	...	560	20.59	...	...	8 pounds to cubic yard.
...	...	Trace.	...	384	Trace.	Trace.	...	Concentrate=1 per cent of original gravel.

[b] The expressions "through 2 on ½" and "through ½" recurring in this and similar columns mean, respectively, sifted through a 2-millimeter mesh screen and remaining on a ½-millimeter mesh screen, and sifted through a ½-millimeter mesh screen.

[c] Platinum valued at $30 per ounce fine.

Mineral composition of various black sands of

Serial number.	Locality.	Magnetite.	Chromite.	Ilmenite.	Garnet.	Hematite.	Olivine.
	CALIFORNIA.	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*
R 3659, No. 1	Alameda County, East Oakland.	456					
R 3506	Amador County, near Volcano.			168			
	Butte County:						
P 226	Magalia	1,330	222			342	
R 3450	Do	744				616	
R 3051	Butte Creek, Nimshew	170				800	
P 270	Do	356	111.6	14		84	114
R 3025	Oroville	1,400	250	150		150	
R 3484	Do	248					
R 3483	Do	104					
R 3482	Do	704		80			
R 3481	Do	1,352	40	520			
R 3479	Do	976	320	216			
R 3478	Do	50					
R 3477	Do	960	Trace.	224			
R 3410	Do	10					
P 625 B	Do	342	4	78		4	
P 675	Do	2	Trace.	Trace.	Trace.		
P 462	Sterling City	1,812		100			
P 206	Do	1,624	70			144	
P 368 through ½	Cherokee	6	32	18	Trace.		
P 368 through 2 on ½	Do		20				
P 436 A	Do	16	356				26
P 436 B	Do	86	392	68	8		
R 3549	Little Rock Creek	1,440		352		16	
R 3207	Brush Creek	1,160		240			
R 3164	Buchannan Hill	160	320				
R 3315	Lovelock	1,240	336	Trace.		168	
R 3323	Inskip	1,336		656	Trace.		
	Calaveras County:						
R 3194	Douglas Flat	120				1,104	
R 3172	San Andreas						
R 3590	Do	16		368	196		
R 3928, No. 1	Murphy	72				320	
R 3928, No. 2	Do	152				560	
R 3928, No. 3	Do	24		1,600		232	
R 3966	Do	360		320		24	
R 3535	Do	1,416		200		200	
R 3286	Wallace	544		1,152		80	
R 3287	Do	408		1,200		160	

[a] Largely pyrite.

the United States, by localities—Continued.

Monazite.	Limonite.	Zircon.	Quartz.	Unclassified.	Gold.	Platinum.	Gold and platinum.	Remarks.
Pounds per ton.	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Dollars per ton.*	*Dollars per ton.*	*Dollars per ton.*	
...	...	...	...	1,544	Trace.	...	...	
...	...	...	...	1,832	69.86	...	...	8 pounds to ton of gravel.
...	...	Trace.	94	10	...	...	37.21	Worked by drifting.
...	552	...	88	...	52.71	...	...	Brown sand from ground sluicing.
...	...	...	...	1,030	107.90	510.00	...	1 pound to 50 tons of gravel.
...	...	1	157	1,159	73.07		...	
...	...	...	100	...	412.16	823.50	...	Black sand from dredge clean-up.
...	...	...	1,500	250	Trace.	...	...	Tailings of same after concentrating on Pinder table.
...	...	...	...	1,900	Trace.	...	...	Middlings of same after concentrating on Pinder table.
...	...	Trace.	...	1,216	.41	...	...	Do.
...	...	Trace.	...	88	.41	...	...	
...	...	48	...	460	Trace.	...	...	
...	...	Trace.	...	1,950	...	...	None.	Tailings from Wilfley table on Oroville tailings.
...	...	...	...	816	...	...	None.	
...	...	...	500	1,490	149.24	...	...	Trace copper. From first 3 riffles, 4 pounds per day.
...	...	4	1,000	568	...	...	1.65	Black sand from dredge clean-up.
...	...	Trace.	1,200	798	.07	...	...	Tailings from dredge.
...	...	22	26	40	...	...	11.99	Concentration not known.
...	...	52	80	30	5.99	...	...	Black sand from sluice box.
...	12	20	728	1,180	...	48.88	...	Old tailing dump (fine sand); pannings.
...	24	Trace.	1,000	956	...	60.98	...	Old tailing dump (coarse sand); pannings.
...	...	372	992	238	...	...	75.74	Pannings from old dumps.
...	...	230	746	424	...	...	83.51	46 pounds antimonide of nickel.
Trace.	...	184	...	8	19.64	...	...	Very plentiful; ground sluicing.
...	...	20	...	580	145.31	24.90	...	4 pounds per cubic yard.
...	...	Trace.	...	1,496	22.53	2.40	...	Concentrated to $\frac{1}{150}$.
...	...	Trace.	...	256	143.17	...	...	Worked by sluicing.
...	...	Trace.	...	8	80.20	...	...	Trace copper; concentration not known.
...	...	64	...	712	807.78	10.50	...	Concentrated from 60 tons to 100 pounds.
...	...	...	...	*a* 2,000	6.82	...	...	Sluicing.
...	...	...	...	1,420	361.31	...	...	60 pounds per day.
...	240	...	...	1,368	3.51	...	...	5 per cent of gravel.
...	...	...	...	1,288	6.20	...	...	0.5 per cent of gravel.
...	72	...	68	4	.62	...	...	1.5 per cent of gravel.
...	...	...	...	1,296	...	...	None.	Pannings from 500 pounds.
...	...	...	80	104	...	...	None.	Original sand.
...	...	128	...	88	85.37	...	...	Concentration not known.
...	...	...	...	232	29.64	...	...	Do.

Mineral composition of various black sands of

Serial number.	Locality.	Magnetite.	Chromite.	Ilmenite.	Garnet.	Hematite.	Olivine.
	CALIFORNIA—continued.						
	Del Norte County:	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*
P 99	Crescent City	480	210		503		574
P 695	Do	324	82	186	12		
P 100 A	Gilbert Creek	50	49		24		73
P 119	Do	921	261		348		212
P 100 B	Smith River	841	509		83		367
	Eldorado County:						
R 3217	Brownsville district	382		280			
R 3587	Green Valley	1,432		232		224	
R 3406	Placerville	32		1,500	128		
R 3869	Virner	1,680		80		80	
R 3440	Grizzly Flats	1,264		640			
	Humboldt County:						
P 89 A	Gold Bluff	245	75		172		818
P 89 B	Do	469	103		435		666
P 89 C	Do	103	21		70		836
P 744 B through ½	Do	38	a 52				8
P 744 B through 1	Do	18	a 20				Trace.
P 744 B through 2	Do	26	a 44				20
P 744 B through 2	Do	24	a 36				8
P 744 C through 2	Do	130	a 108				2
P 744 D through 1	Do	134	a 124				6
P 130 C	Upper Gold Bluff	1,568	28	238	2		
P 130 B through 2 on ½.	Do	25	1		9		2
P 124	Orleans	899	388				
P 794 A	Do	820	84			18	
P 794 B	Do	1,214	178			178	
P 794 C	Do	636	254			770	
P 794 D	Do	1,370	148			34	
R 3145	Do	1,688	208		96		
P 195 on ½	Orleans Bar	1	1		.5		.1
P 195 through ½	Do	145	7	.1	.1		742
R 3991	Trinidad	16					
R 3992	Do	16					
R 3993	Do						
R 3994	Do	104					
R 3989	Do	360	620				
P 740	Do	58	38	22	Trace.		
P 130 B through ½	Orick and Trinidad	61	70		45		507
P 130 B through 2 on ½.	Do	25	1		8		3

a Includes ilmenite.

the United States, by localities—Continued.

Monazite.	Limonite.	Zircon.	Quartz.	Unclassified.	Gold.	Platinum.	Gold and platinum.	Remarks.
Pounds per ton.	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Dollars per ton.*	*Dollars per ton.*	*Dollars per ton.*	
56	....	44	133	....	0.24	....	....	Natural sand not concentrated.
....	....	20	376	....	.17	....	....	Do.
.1	....	1	1,035	760	....	....	None.	Do.
....	....	19	115	125	1.24	....	....	Heavy tailings from sluice box.
....	....	18	231	27	2.45	....	....	Heavy tailings after gold removed by sluicing.
Trace.	....	80	....	1,260	392.31	....	....	1 pound obtained from 7 cubic yards; trace of copper and 250 pounds rutile.
....	....	Trace.	112	....	130.22	....	....	Brown sand concentrates.
Trace.	....	176	88	20	785.46	....	....	Copper scales 8 pounds per day.
....	....	....	....	*a* 160	122.09	....	....	1 pound per 10 tons, tailings escaped amalgamation.
....	....	16	....	96	.85	....	....	1 pound per ton sluicing.
....	....	17	594	99	....	....	6.01	Selected streak of beach sand.
....	....	17	310	....	....	....	None.	Tailings from above.
....	....	3	800	167	....	....	1.19	Ordinary beach sand.
....	....	6	....	....	....	....	.37	Includes ilmenite.
....	....	2	....	....	....	....	.45	Beach sand.
....	....	16	....	....	....	....	.17	Do.
....	....	6	....	....	....	....	.17	Do.
....	....	10	....	....	....	....	.74	Do.
....	....	14	....	....	....	....	15.09	Concentrated by panning beach sand.
....	6	12	26	120	....	22.12	....	Trace of cinnabar; beach concentrates.
....	....	.9	980	983	....	....	Trace.	
....	....	4	301	407	1,104.00	....	....	Heavy sand in sluice boxes panned to $\frac{1}{16}$.
....	....	....	....	1,078	....	....	No assay.	
....	....	....	....	430	....	....	No assay.	
....	....	....	....	218	....	....	No assay.	122 pounds pyrite.
....	....	4	118	324	....	....	481.61	Clean-up of placer mine.
....	....	....	....	8	392.73	120.00	....	Clean-up of hydraulic mine; shows cinnabar.
....	....	.1	727	1,269	....	....	No assay.	
....	....	.1	275	828	....	....	No assay.	
....	....	....	....	1,984	....	....	None.	Natural sand.
....	....	....	....	1,984	....	....	None.	Do.
Trace.	....	....	....	2,000	....	....	None.	Do.
....	....	....	....	1,896	....	....	None.	Do.
....	....	80	....	940	1.45	1.03	....	Beach sand, 3 feet below surface.
....	....	....	....	....	1.24	....	....	Do.
....	....	7	926	383	....	....	.17	Natural beach sand.
....	....	.2	980	982	....	....	....	Do.

Mineral composition of various black sands of

Serial number.	Locality.	Magnetite.	Chromite.	Ilmenite.	Garnet.	Hematite.	Olivine.
	CALIFORNIA—continued.						
	Kern County:	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*
R 3525	Kane Springs	912		24		512	
R 3403	Vaughn	10		1,000			
R 3495	Ricardo	1,624				200	
P 620	Los Angeles County, Ocean Park.	54		30	8	[a]3	30
	Mendocino County:						
P 103 A	Fort Bragg	4			1,874		18
P 103 B	Do	3	4		2		
R 3355	Modoc County, Feather River	1,136		40		720	
R 3646	Monterey County, Los Burros district.				480	80	
	Nevada County:						
P 260	Rough and Ready	150	632	844		100	
P 260 through ½	Do	492	833		446		.3
R 3210	Do	500	200	800		200	
R 3387	Nevada City			1,024			
R 3342	North Bloomfield	8	200	200			
R 3492	Relief Hill	280	360	816			
R 3599, No. 1	Orange County, Fullerton	408		160		80	
	Placer County:						
R 3074	Butcher Ranch	1,000				400	
R 3033	North Fork American River	850	160			300	
R 3076	East Auburn	1,600				350	
R 3137	Blue Canyon	1,560	320				
R 3318	Loomis	8	992				
R 3068	Michigan Bluff	1,528	352				
R 3610, No. 1	Weimar						
R 3610, No. 2	Do						
R 3459	Do						
R 3789, No. 2	Do	32					
P 605 A	Gold Run	648		648		88	
P 605 B	Do	548		646		64	
	Plumas County:						
P 304	Spanish Ranch	1,760		218			
R 3460	Crescent Mills	968		800		104	
R 3214	Genesee	1,520		80			
R 3297	La Porte	1,120	32	576			
R 3298	Do	1,151	340	384			
R 3161	Nelson Point	1,774		240			
R 3939	Do	1,040		80		80	
R 3655, No. 2		1,456	50	376	60		
R 3160	Rock Island Hill	888	496				
R 3162	Riverside County, Holcomb	736			32	1,120	
P 95	Sacramento County, Michigan Bar.	359	1,121				

[a] Titaniferous hematite.

the United States, by localities—Continued.

Monazite.	Limonite.	Zircon.	Quartz.	Unclassified.	Gold.	Platinum.	Gold and platinum.	Remarks.
Pounds per ton.	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Dollars per ton.*	*Dollars per ton.*	*Dollars per ton.*	
....	....	....	500	52	14.88	3.00	....	400 pounds per ton gravel.
....	....	....	....	990	.41	....	....	20 pounds per ton of gravel.
....	....	....	....	175	5.79	....	....	16 pounds per ton of gravel, dry washing.
....	....	2	1,766	103	....	....	....	Beach sand.
....	....	34	36	31	.11	....	....	Not concentrated.
....	....	5	536	1,447	.17	....	....	Do.
....	....	Trace.	....	104	257.75	....	....	Ground sluicing, concentration not known.
....	....	....	....	1,440	36.79	....	....	1 pound to 8 cubic yards of gravel.
4	....	....	150	124	393.22	....	....	Concentration not known.
....	....	14	156	55	236.67	....	....	Do.
....	....	50	....	250	115.75	15.60	....	Heavy sand from hydraulic clean-up.
....	....	928	....	4	9.30	....	....	Old river channel.
....	....	Trace.	....	1,400	90.53	....	....	1 pound to 6 tons, drifting.
....	....	....	....	550	1,011.31	106.50	....	9 pounds per ton of gravel.
....	....	....	....	1,352	....	....	None.	Natural sand.
....	....	....	160	440	3,960.37	100.80	....	Concentrates from vein matter.
....	....	340	....	350	604.80	38.10	....	50 pounds per ton of gravel.
....	....	....	....	50	498.97	44.40	....	1 pound per 40 tons of gravel.
....	....	Trace.	....	96	2,623.20	290.10	....	Concentration not known.
Trace.	....	Trace.	....	1,000	68.42	....	....	50 pounds per ton of gravel.
....	....	....	....	120	58.08	....	....	3 pounds per ton of gravel.
....	....	....	2,000	....	.62	....	....	50 pounds per ton of gravel.
....	....	....	2,000	....	2.69	....	....	30 pounds per ton of gravel.
....	....	....	2,000	....	10.75	....	....	35 pounds per ton of gravel.
....	....	....	....	1,968	17.36	....	....	30 pounds per ton of gravel.
....	22	192	238	164	32.28	....	....	$\frac{1}{2}$ pound per cubic yard of gravel.
....	16	202	236	286	35.01	....	....	Assay shows copper, $\frac{1}{2}$ pound to 1 cubic yard of gravel.
....	....	20	....	....	1,373.70	....	....	9 pounds per ton of gravel.
....	....	....	128	....	630.64	....	....	Concentration not known.
....	....	....	....	400	29.76	19.80	....	Concentration not known; drifting.
....	....	....	....	104	61.54	6.30	....	Concentrated in sluice box.
....	....	....	28	83	27.08	....	....	Do.
....	....	Trace.	8	8	29.97	3.60	....	$\frac{3}{5}$ pound per 1 cubic yard.
....	80	....	700	20	16.32	.04	....	$\frac{1}{2}$ pound per 1 cubic yard.
10	....	....	48	....	Trace.	....	....	Concentration not known.
....	....	88	....	488	223.24	4.80	....	Do.
....	....	40	40	....	2.48	1.80	....	12 pounds per cubic yard of gravel.
....	....	316	94	108	....	....	144.33	Concentration not known.

Mineral composition of various black sands of

Serial number.	Locality.	Magnetite.	Chromite.	Ilmenite.	Garnet.	Hematite.	Olivine.
	CALIFORNIA—continued.						
	San Bernardino County:	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*
R 3716, No. 1	Needles	1,336		136	144	288	
R 3716, No. 2	Do	256		336	Trace.		
R 3716, No. 3	Do	264		344	168		
R 3716, No. 5	Do	776	Trace.	320			
R 3716, No. 6	Do	472		480	112		
	San Luis Obispo County:						
R 3057	La Panza	1,112	256		Trace.	435	
R 3527	Do	680				124	
P 487	Beach Sand	58		362	428		
P 610	San Francisco	23		14	4		4
P 120 A	San Mateo County, Beach Sand.	356	1,022		14		290
	Santa Barbara County:						
P 188 A	Point Sal	106	188	420	1,148		
P 188 B	Do	268	172	728	622		
P 188 C	Do	62	22	240	506		
P 188 D	Do	38	40	178	264		
	Santa Cruz County:						
P 131	Aptos	668	8	340	10		9
P 131	Do	502	26	230			4
P 131	Do	668	126	224	2		52
P 131	Do	672	72	250	1		62
R 3502	Do	1,120		480		164	
R 3375	Do	1,016		576	80		
	Shasta County:						
P 414	French Gulch	1,496	200	240			
R 3189	Redding	1,164		208			
R 3607	Do			16			
R 3641, No. 1	Round Mountain	672		692	176		
R 3641, No. 2	Do						
R 3697	Sacramento River		800			600	
	Siskiyou County:						
P 168 B	Callahan	843	756				
P 168 C	Do	981	108				
R 3181	Do	584	32				
R 3154	Callahan (Grouse Creek)	488	1,464				
R 3072	Callahan (Jackson Creek)	900		500			
P 769	Happy Camp	928	156	328			
P 770	Sciard Valley	1,286	334	50			
P 207	Cecilville	1,824	56	18	18		
P 156	Forks of Salomon	1,152	66	530	12		68
P 157	Sawyers Bar	234		234			
R 3073	Scott River	1,300	300	200			

the United States, by localities—Continued.

Monazite.	Limonite.	Zircon.	Quartz.	Unclassified.	Gold.	Platinum.	Gold and platinum.	Remarks.
Pounds per ton.	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Dollars per ton.*	*Dollars per ton.*	*Dollars per ton.*	
...	...	...	88	8	0.21	...	...	13 pounds per ton of gravel; dry washing.
...	...	...	1,248	160	9.10	...	...	50 pounds per ton of gravel.
...	...	...	...	1,224	5.58	...	...	50 pounds per ton of gravel; dry washing.
...	...	...	904	...	26.25	...	...	20 pounds per ton of gravel.
...	...	...	800	136	22.94	...	...	16 pounds per ton of gravel.
...	...	Trace.	100	100	37.21	...	...	5 pounds per ton of gravel.
...	...	...	1,100	96	181.48	...	...	½ pound per ton of gravel; ground sluicing.
...	...	30	952	170	2.89	...	...	Natural sand.
...	...	2	1,191	762	...	...	None.	
...	...	100	215	...	Trace.	...	...	Do.
...	...	54	...	82	.21	...	...	Not concentrated.
...	...	94	...	114	.10	...	...	Concentrates from sluice box.
...	...	Trace.	972	198	2.07	...	...	Not concentrated.
...	...	12	1,234	172	4.55	...	...	Mixture of natural sands.
...	...	26	752	189	.62	...	...	Natural sand.
...	...	18	1,046	170	.62	...	...	Do.
...	...	22	744	162	.62	...	...	Do.
...	...	24	814	104	.62	...	...	Do.
...	...	...	216	...	...	...	None.	Original sand.
...	...	...	328	...	Trace.	...	...	Do.
...	...	24	10	28	17.98	...	...	Concentration not known.
...	...	40	60	28	171.35	7.50	...	½ pound from 5 tons of gravel.
...	...	32	...	1,952	428.70	...	...	Concentration not known.
...	...	Trace.	400	56	Trace.	...	...	10 pounds per ton of gravel.
...	...	...	1,500	500	...	...	None.	Original gravel.
...	...	...	300	300	69.45	...	...	3 pounds per cubic yard.
...	...	3	178	219	...	...	40.85	Sand from dredge after amalgamation.
...	...	.8	336	573	...	...	...	
...	...	...	1,300	68	14.88	Trace.	...	Concentration unknown; sluicing and drifting.
...	...	...	10	6	213.11	5.40	...	Concentration unknown; hydraulic.
...	...	50	...	550	62.10	...	...	1 pound from 16 cubic yards; ground sluicing.
...	...	...	350	216	...	...	5,029.84	1½ pounds, total amount black sand caught in sluices in one month's run.
...	...	Trace.	...	330	...	...	653.38	85 pounds per ton of sluice-box sand after clean up.
...	...	6	20	56	104.38	...	...	Concentration not known.
...	...	140	22	...	...	...	168.87	Waste material from clean up.
...	...	60	...	1,472	...	...	337.95	Pannings from sluice-box tailings.
...	...	50	...	150	705.26	...	...	1 pound from 10 cubic yards; hydraulic and drift.

Mineral composition of various black sands of

Serial number.	Locality.	Magnetite.	Chromite.	Ilmenite.	Garnet.	Hematite.	Olivine.
	CALIFORNIA—continued.						
	Siskiyou County—Continued.	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*
R 3190	Orofino	32					
R 3067 A	Castella	1,000	300				
R 3656	Shasta River	368		112		984	
R 3344	Beaver Creek	1,568	368				
R 3392	Henley	472					
R 3147	Happy Camp district	1,400	528				
R 3238	Klamath River	112			28		
R 3851	Trinity County	1,200	50	50			
R 3945	Trinity River	640	Trace.	160			
R 3080	Trinity Center	624	480			680	
R 3595	Do	1,520	440				
R 3135	Burnt Ranch	Trace.	Trace.				
R 3864	Douglas City	1,376					
R 3140	Junction City	1,184		352			
R 3773	Do	992		848			
R 3544	Do	1,856	96				
R 3423	Carrville	1,840		102			
P 224	Minersville	1,624	80	214			
P 593	Boulder Creek						
R 3411	Tuolumne County, American Camp.	1,600		150			
	Yuba County:						
P 413	Marysville	1,040		906			
P 685	Do	1,256	Trace.	267			
P 27	Do	562	[b] 122		10		176
R 3499	Brownsville	400		1,400			
R 3500	Do	1,232		360		360	
R 3499 A	Do	25		160		50	
R 3235	Yuba River	520	150	280			
R 3034	Camptonville	25	1,800				
R 3150	Strawberry Valley	1,480		384			
R 3628	Indian Hill	1,232	184	528			
R 3720	Oregon House	832		560		200	
	COLORADO.						
R 3116	Boulder County Caribou:	32					
	Chaffee County:						
P 491 A	Buena Vista	1,012		186	28		
P 491 B	Do	960		446	72		

[a] Mostly pyrite.

the United States, by localities—Continued.

Monazite.	Limonite.	Zircon.	Quartz.	Unclassified.	Gold.	Platinum.	Gold and platinum.	Remarks.
Pounds per ton.	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Dollars per ton.*	*Dollars per ton.*	*Dollars per ton.*	
....	....	....	....	1,968	9.71	....	....	Concentration not known; hydraulic elevator.
....	....	....	150	550	13.23	8.40	....	Concentration not known; drifting.
....	....	....	....	a 536	15.92	....	....	Ground sluicing.
....	....	Trace.	....	96	40.03	....	....	1/5 pound per cubic yard of gravel; ground sluicing.
....	Trace.	....	872	656	80.75	....	....	¼ pound per ton of quartz; gray black sand.
....	....	Trace.	50	22	....	24.60	....	⅜ pound per cubic yard of gravel.
....	....	....	....	a1,860	30.53	....	....	Concentration not known.
....	....	....	300	300	3.51	....	....	1½ pounds per cubic yard of gravel.
....	400	....	400	400	.83	....	....	¾-pound per cubic yard.
....	....	100	....	116	19.84	....	....	Concentration not known.
....	....	....	40	....	27.08	....	....	Ore concentration 10 to 1.
....	....	350	....	1,650	186.44	38.40	....	4½ pounds per cubic yard of gravel.
....	....	....	200	424	23.98	6.60	....	Concentration not known.
....	....	32	....	128	587.65	774.00	....	304 pounds pyrite; hydraulic tailings.
....	....	....	144	16	1.24	....	....	Brown sand; concentration not known.
....	....	....	20	28	162.67	174.90	....	Trace of cinnabar; black sand from riffles.
....	....	25	....	43	70.28	....	....	Trace of cinnabar; 40 pounds per ton of gravel.
....	....	8	24	50	....	....	56.43	1 pound per day.
....	....	....	....	....	82.54	....	....	4 pounds per cubic yard of gravel.
....	....	....	150	50	14.05	....	....	50 pounds rutile; 1 pound per cubic yard of gravel.
....	....	4	2	48	23.56	....	....	From sluice boxes.
....	....	Trace.	....	....	2.19	....	....	From dredges; concentration not known.
Trace.	....	3	714	....	.97	....	....	Concentration not known.
....	....	....	104	96	83.71	....	....	15 pounds per ton of gravel; ground sluicing.
....	....	Trace.	....	48	136.00	....	....	30 pounds per ton of gravel; ground sluicing.
....	....	....	300	1.460	3.72	3.60	....	
....	....	....	900	150	78.75	....	....	Gray sand from river; 4 pounds per ton of gravel.
....	....	40	....	135	537.42	....	....	1 pound per 3 cubic yards of gravel.
....	....	Trace.	50	86	27.49	....	....	Concentration not known; hand rocker.
....	....	....	136	....	212.49	100.80	....	Concentration not known; drifting and sluicing.
....	....	....	....	c 408	....	....	None.	200 pounds per cubic yard.
....	....	....	1,500	320	.62	....	....	Pyrite; 75 pounds per ton of gravel; shaft working.
20	....	....	664	90	2.46	....	....	Concentration not known.
....	....	72	422	30	.54	....	....	Do.

b Includes ilmenite. c A little quartz.

Mineral composition of various black sands of

Serial number.	Locality.	Magnetite.	Chromite.	Ilmenite.	Garnet.	Hematite.	Olivine.
	COLORADO—continued.						
	Chaffee County—Continued.	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*
P 136	Buena Vista	1,248	....	462	83	....	3
R 3127	Do	1,424	....	232	96	....	....
R 3425	Do	1,248	....	150	350	150	....
R 3537	Do	1,472	....	168	80	168	....
R 3871	Arkansas River (near Salida).	1,344	....	Trace.	320	192	....
R 3128	Arkansas River, Brown Canyon.	1,760	....	....	....	104	....
R 3596	Arkansas River	1,320	....	160	160	....	....
R 3803	Clear Creek County, Grouse Mountain.	....	....	....	....	600	....
	Costilla County:						
R 3683	Grayback	1,520	....	80	....	136	....
R 3040	San Lina Valley	1,008	452	500	....	....	....
R 3095	San Luis Valley	1,208	....	....	....	256	....
R 3523	Eagle County, Grand River	1,168	....	....	56	584	....
R 3712	El Paso County, Colorado City.	8	....	760	Trace.	768	....
R 3088	Fremont County, Coaldale	1,000	50	200	....	....	....
	Gilpin County:						
P 227	Central City	1,458	....	194	....	48	....
R 3129	Russell and Lake district	1,568	....	....	80	192	....
R 3976	Kansas district	880	....	....	128	[a] 480	....
R 3452	Gunnison County, Lake Fork	688	....	....	....	....	....
P 205	Huerfano County, La Veta	1,522	....	154	16	184	....
R 3429	Jefferson County, Golden	1,450	....	50	50	350	....
R 3760	Larimer County, Independence Mount.	112	....	488	....	....	....
P 117	Ouray County, Ouray	814	....	....	....	....	....
	Park County:						
R 3558	Fair Play	1,776	....	....	....	32	....
R 3113	....	776	200	....	....	128	....
	Pitkin County:						
P 211	Aspen	....	....	....	....	....	....
R 3099	Do	....	....	....	....	....	....
P 846	Rio Grande County, Monte Vista.	620	182	150	16	....	....
	Routt County:						
R 3793	Hahn's Peak	16	....	....	....	1,408	....
R 3608	Timber Lake	128	....	792	448	....	....
R 3609	Do	....	....	584	512	....	....
	Saguache County:						
R 3121 No. 2	Liberty	1,912	....	....	....	....	....
R 3121 No. 3	Do	232	....	....	....	....	....
R 3520	San Juan County, Burro Bridge	....	....	80	....	936	....

[a] Includes ilmenite.

the United States, by localities—Continued.

Monazite.	Limonite.	Zircon.	Quartz.	Unclassified.	Gold.	Platinum.	Gold and platinum.	Remarks.
Pounds per ton.	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Dollars per ton.*	*Dollars per ton.*	*Dollars per ton.*	
28	...	82	68	22	...	...	None.	Concentration not known.
...	...	Trace.	144	96	41.13	12.90	...	27 pounds per cubic yard of gravel.
...	...	...	100	...	15.92	...	...	9 pounds per cubic yard of gravel.
32	...	56	24	...	Trace.	...	...	Concentration not known.
...	...	48	56	40	16 12	...	...	135 pounds per ton of gravel.
...	...	136	...	...	24.18	...	...	1 pound per cubic yard of gravel.
...	...	...	280	80	10.34	...	...	75 pounds per ton of gravel.
...	1,000	...	150	250	19.64	...	...	400 pounds per ton of gravel; tunneling by hand.
...	...	...	100	164	17.78	...	...	
30	...	10	...	...	...	...	None.	200 pounds per ton of gravel.
Trace.	...	Trace.	...	536	...	Trace.	...	225 pounds per ton of gravel.
...	...	20	...	172	17.57	...	...	25 pounds per ton of gravel; ground sluicing.
...	...	...	300	164	...	...	None.	650 pounds per ton of gravel.
...	...	...	700	50	44.44	...	...	25 pounds per ton of gravel; sluicing.
Trace.	...	...	290	10	8.68	...	...	20 pounds per cubic yard of gravel.
...	...	Trace.	160	...	17.78	...	...	15 pounds per ton of gravel; placer.
...	...	...	...	512	...	...	None.	140 pounds per ton of gravel.
...	...	...	1,312	...	...	...	None.	300 pounds per ton gravel; sluicing and rockers.
...	...	16	86	22	Trace.	...	...	4 pounds per cubic yard.
...	...	Trace.	10	90	1.24	...	...	6 pounds per cubic yard; dredge and rocker.
...	...	...	...	1,040	2.48	...	...	60 pounds per ton gravel.
...	...	...	417	768	22.70	...	...	Concentration not known.
...	...	...	104	88	291.45	...	...	1½ pounds per cubic yard gravel.
...	...	...	500	372	22.12	...	...	Gold removed by sluicing.
...	62	...	230	...	Trace.	...	...	1,306=cerusite; 402=galena; 400 pounds per ton of gravel.
...	...	...	...	[b]2,000	1.03	1.50	...	600 pounds per ton of gravel. Fissure vein; tunnel.
...	...	...	266	766	...	...	No trace.	Not concentrated.
Trace.	...	100	140	6	30.53	...	...	Concentration not known.
416	...	Trace.	196	...	4.55	...	...	Do.
520	...	80	304	...	19.02	...	...	Do.
...	...	...	40	48	...	...	None.	Do.
...	...	...	600	1,136	7.03	1.80	...	Do.
...	384	...	...	680	297.43	...	...	1 pound in 7 cubic yards gravel.

[b] Largely galena.

Mineral composition of various black sands of

Serial number.	Locality.	Magnetite.	Chromite.	Ilmenite.	Garnet.	Hematite.	Olivine.
	COLORADO—continued.						
	San Miguel County:	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*
R 3722	Newmire	48					
R 3126	Telluride	192	72	72			
	Summit County:						
R 3125	Breckenridge	952		968	Trace.		
R 3350	Do	1,112		696	64	48	
R 3414	Southswan	1,300			350	60	
R 3508	Teller County, Victor	744		112		904	
	IDAHO.						
	Ada County:						
P 36	Boise	26	200		709		
P 81 A	Do	946	51		554		227
P 111 A	Do	[a]1,092	[b]646				
P 111 B	Do	513	[b]951				
P 111 C	Do	782	[b]746				
P 105	Do	3	3		10		
P 113	Do	7			1		1
P 150	Do	540		826			
P 50 A	Do	38	[c]1		2		
P 50 B	Do	1,629	[c]2		2		4
R 3737	Do	216	[c]80	248	400	96	
R 3516	Do						
P 138	Boise basin	1,244		344			
R 3052	Payette River	1,640		118	40		
P 365 through ½	Payette	84	Trace.	6	3		
P 365 through 2 on ½	Do	26		Trace.			
R 3042	Near Ontario	800		200	400	100	
	Bannock County:						
P 281 A	Pocatello						
P 281	Do						
	Bingham County:						
P 369	Rich	48		64	10		
P 263	Otis	70		36			
P 418	Rich	290		90	38		
P 735	Blackfoot	1,118		616	50		
P 835	Do	726		436	356	[d]152	
R 3054	Snake River sand	688		138			
R 3174	Do	864		664			
R 3668	Do	888		112			
R 3908	Do	1,032		80		40	
	Blaine County:						
P 275	Snake River near Wapi	72		39	17		11
R 3247	Hailey	1,176		144			
R 3049	Do	392				300	
R 3690		208					

[a] Includes hematite. [b] Includes rutile.

the United States, by localities—Continued.

Monazite.	Limonite.	Zircon.	Quartz.	Unclassified.	Gold.	Platinum.	Gold and platinum.	Remarks.
Pounds per ton.	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Dollars per ton.*	*Dollars per ton.*	*Dollars per ton.*	
			904	1,048	49.19			Concentration not known.
			80	1,576	7.65	2.70		1 pound to 3 cubic yards of gravel.
			64				231.50	10 pounds per cubic yard.
				64	172.42			Concentration not known.
			170	120			None.	200 pounds per ton of gravel.
		Trace.	200	40	7.85			Concentration not known.
219.6		231	579		1.03			Concentration not known; piping.
			220		12.50			1 ton to 140 cubic yards gravel.
		100	20	139	173.40			Concentration unknown.
		23	281	231	7.29			Do.
		21	292	157	14.71			
		.3	1,606	376	.78			1,000 pounds per ton of gravel.
		.1	1,502	487				
94		34	382	124			No assay.	Concentration not known.
27.3		27	1,735	168			No assay.	
58.7		8	49	245			No assay.	
Trace.		Trace.	1,000	40	344.98			3 pounds per cubic yard gravel; rocker.
			1,600	400	Trace.			Concentration not known; sluice.
250		6	106	48	7.61			Concentration not known.
			202		10.75	8.40		70 pounds per ton of gravel.
			1,692	288	.12			Concentration not known.
			1,630	362	.35			Do.
		100		400	4.55			2½ pounds per cubic yard gravel.
					.37			
					.50			
		16		1,878	25.1			65 pounds per cubic yard gravel.
		50	1,536	310	1.24			Concentration not known.
			1,448	132	61.02			1½ pounds from each yard gravel; ground sluice.
		150	14	50	674.26			35 pounds per ton of gravel.
		174	36	120	73.38			Concentration not known.
		Trace.	614	560	405.55	5.40		Do.
		112	200	136	33.07	21.00		1¼ pounds per ton of tailings; ground sluicing.
		160	840		62.63			1 pound per yard gravel.
Trace.		80		768	1,154.37			Concentration not known.
		8	1,317	533	.71			Not concentrated.
				680	70.69			Concentration not known.
			902	406	4.75			Do.
				1,800	158.94			1 pound per cubic yard of gravel.

[c] Includes ilmenite.

[d] Titaniferous.

Mineral composition of various black sands of

Serial number.	Locality.	Magnetite.	Chromite.	Ilmenite.	Garnet.	Hematite.	Olivine.
	IDAHO—continued.						
	Boise County:	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*
P 249 through ½	Centerville	6	18		Trace.		
P 249 through 2 on ½	Do	1		4	14	22	
P 771	Do	12		38	38		
P 657 A through ½	Do	6	14	32	14		
P 657 A through 2 on ½.	Do	Trace.	Trace.	8	Trace.		
P 657 B	Do	4	2	10	2		
P 277 B	Grimes Creek near Centerville.	264		782			
P 277 C	Do						
P 277 D	Do	Trace.					
P 277 E	Do	1,624		102			
P 277 F	Do	330		702			
P 277 G	Do	396		792			
P 277 A	Do	244	337	347	29		
R 3393	Red Fox claim, Centerville district.	864		568	128		
P 655 A	Placerville	182		26		42	
P 655 B	Do	68	Trace.	90			
P 670	Do	1,448		198			
R 3202	Lardo	1,480		250	210		
R 3258	Garden Valley	1,864		56	16	Trace.	
R 3349	Marsh	416		536	180	512	
R 3654	Gold Fork	1,072		624	88		
R 3730	Highland	1,104		24	264	24	
P 654 through ½	Idaho City	82		378	414		
P 654 through 2 on ½	Do	196		126	558		
R 3237	Canyon County, Payette River.	1,744		100	40		
	Custer County:						
P 74	Robinson	886	616		452		
R 3704	....	128		96	32	144	
	Elmore County:						
P 107	Wood Creek	1,721	[b] 221				
R 3187	Neal mining district				1,240		
R 3050	Mountainhome	100				100	
R 3071	Rockybar	1,520	40	200			
R 3740	South Boise River near Pine.	1,624		48	40	32	
R 3447	Middle Boise River	1,768			32	96	
R 3833	Do	1,600			100	75	
	Fremont County:						
R 3254	Menan	1,928					
R 3252	Do	1,952	8				
	Idaho County:						
P 219	Elk City	978		336		136	
P 294 through ½	Do	60		210	10		
P 294 2 on ½	Do	208	1,317				
P 433	Elk City district	1,162		428			

[a] Trace of cinnabar.

the United States, by localities—Continued.

Monazite.	Limonite.	Zircon.	Quartz.	Unclassified.	Gold.	Platinum.	Gold and platinum.	Remarks.
Pounds per ton.	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Dollars per ton.*	*Dollars per ton.*	*Dollars per ton.*	
2		Trace.	104	1,870	1.20			Sand from dump of tailings.
		1	1,889	88	.04			10 pounds chlorite and rutile.
286		90			247.83			Concentration not known.
4		6			8.90			Do.
Trace.		Trace.			2.48			Do.
4		2			1.34			Do.
358	398		556	40			No assay.	Old hydraulic placer ground.
	238		1,604				No assay.	Ore.
			1,570	190			No assay.	Concentration not known.
240		36					No assay.	Do.
68			892	10	26.46			Do.
Trace.			762	52	74.41			Screenings from old dump.
30		12	1,251	80	7.62			Concentration unknown.
224		100	120		352.04			1 pound per ton of gravel.
142		12			109.53			Trace cinnabar, 2 pounds bismutite.
36		4			3.15			
170		34	106	44			8.87	3 pounds per 5 cubic yards gravel; gold removed.
20		30		10	43.28			½ pound from 1 day's run over riffles.
32		24			57.66			260 pounds to ton of gravel.
38		38		228	16.54			11 pounds to ton of gravel.
			216				None.	
		160		424	71.10			30 pounds per cubic yard.
42		360	642	82	349.94			Sand from sluice boxes, before amalgamation.
		192	928		526.05			Do.
6		8		100	7.23			Natural sand.
		[a]32.9	7		7.22			
		112		1,600	.83			
		5	51.8		Trace.			
			700	44	12.20			Concentration 1 to 20.
			1,500	300	21.50			Do.
		Trace.	100	140	22.32	2.27		5 pounds per cubic yard of gravel.
		Trace.	256		19.77			2 pounds per cubic yard of gravel.
		Trace.	104		8.89			
			100	125	20.26			35 pounds per cubic yard of gravel.
				72			Trace.	Concentration 5 to 1.
		Trace.	20	20			Trace.	
26		18	270	204	5.79			2 pounds mica; 40 pounds per ton.
40		10	1,520	160	40.00			Concentration not known.
108			334	33	27.04			Do.
6		6	384	14	1.93			After amalgamation.

[b] Includes ilmenite and titanite.

Mineral composition of various black sands of

Serial number.	Locality.	Magnetite.	Chromite.	Ilmenite.	Garnet.	Hematite.	Olivine.
	IDAHO—continued.						
	Idaho County—Continued.	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*
R 3257	Elk City district	80		696	296	Trace.	
R 3568	Do			720	120	80	
P 641	Resort	196		470			
R 3366	Florence			1,520	160		
R 3288	Do	744		944			
R 3442	Do	200					
R 3443	Do	1,464		248		32	
R 3444	Do	720		120			
R 3389	Dixie	1,032					
R 3943	Marshall Lake district	80		136			
R 3261	Baker Gulch, Crooked River.	720		624		240	
R 3615	Penmans Fork, Big Creek	640		520	80		
R 3534	Pardee			688	112	124	
R 3554	Salmon River	840		440	400		
R 3385	Syringa	192		1,584			
R 3602	Camp Howard district	1,285		308	153		
	Latah County:						
P 412	Freese	1,698				46	
R 3273	Hoodoo mining district	72			1,864	24	
R 3394	Do	700		900		300	
R 3509	Woodfell	24			1,688	40	
	Lemhi County:						
P 66	Leesburg	[a]1,807			37		
R 3060	Do	192		1,340		224	
R 3256 A	Do	72				1,744	
P 31 A	Leesburg Basin, Arnet Creek	959	832		116		
P 31 B	Leesburg Basin, Camp Creek.	1,290	474		56		14
P 31 C	Leesburg Basin, Wards Gulch.	747	859		128		
P 31 D	Leesburg Basin	433	477				
P 31 E	Do	1,939	1		4		
R 3243	Gibbonsville	200	Trace.	1,096			
	Lincoln County:						
P 839 E	Minidoka						
P 839 A	Minidoka, Snake River	1		Trace.	Trace.	[b] Trace.	
P 839 B	Minidoka	2		Trace.	Trace.	[b] Trace.	
P 839 C	Do	4		Trace.	2	[b] Trace.	
P 653 through ½	Do	8		4	4		
P 653 through 2 on ½	Do	Trace.		Trace.	Trace.		
P 40	Shoshone	174	15		80		
R 3652, No. 1	Snake River near Milner	1,976					
R 3652, No. 2	Do			16	560		
R 3821	Do	100					
P 182	Near Wapi	Trace.		Trace.			
	Nez Perce County:						
P 149	Orofino	768		1,000	20		
P 283 through ½	Dent	6	280	540	414		

[a] Includes hematite.

the United States, by localities—Continued.

Monazite.	Limonite.	Zircon.	Quartz.	Unclassified.	Gold.	Platinum.	Gold and platinum.	Remarks.
Pounds per ton.	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Dollars per ton.*	*Dollars per ton.*	*Dollars per ton.*	
728		Trace.		200	2.19	1.50		14 pounds per ton of gravel.
808		120		24	125.88			Concentration not known.
112			638	584	42.79			1 pound per 1½ cubic yards of gravel.
Trace.			320		62.42			Concentration not known.
		Trace.	250	62	22.32			10½ pounds per cubic yard.
	1,400	Trace.	200	200	165.08			Trace apatite; placer concentrates.
			248		13.44			Placer concentrates.
	128	344	688		146.14			Do.
		Trace.	800	168	41.75			Concentration not known.
376		1,408			50.85			Trace cinnabar, 1 pound from 3 cubic yards.
320				96			Trace.	
528		Trace.	224		188.72			1 pound per ton of gravel.
		Trace.	1 000	76	Trace.			
			216	104	411.54			40 pounds per ton of gravel.
Trace.			224				None.	
Trace.		100		154	223.24			2½ pounds per ton of gravel.
			42	172	25.01			42 pounds titaniferous hematite; concentration not known.
				32	18.75			Left in sluice boxes.
			100		116.17			Do.
			200		.62			
20			135				6.63	Concentration not known.
44		200			66.76			Do.
		88		96	40.16			Do.
.5		1			86.81			Do.
		.6			Trace.			Do.
5		60	73		43.54			Do.
10			65		2.69			Do.
.5		.9	8		No assay.			
		Trace.	500	204	126.08			2 pounds per cubic yard.
					5.37			Wilfley concentrates.
		Trace.			.08			Natural sand.
		Trace.			.10			Do.
	Trace.	Trace.			.13			Do.
					1.45			Do.
8		Trace.			.41			Diaspore; 66 pounds apatite.
26		46	1,441		26.33			50 pounds per day.
				24			None.	
		152	152	1,130	9.51			30 pounds per ton after amalgamation.
				1,900	39.89			20 pounds per day.
			1,784	215			.31	Natural sand.
88		76	24	20			None.	Concentration not known.
126			586	26	19.33			20 pounds rutile; 14 pounds per yard.

[b] Titaniferous hematite.

Mineral composition of various black sands of

Serial number.	Locality.	Magnetite.	Chromite.	Ilmenite.	Garnet.	Hematite.	Olivine.
	IDAHO—continued.						
	Nez Perce County—Cont'd.	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*
P 283 through 2 on ½	Dent	Trace.	1,432		265		
P 627	Lewiston, Clearwater River	90		580	360		
P 93	Salmon River	981	688		113		36
R 3131	North Fork, Clearwater River.	424		468	636		
	Oneida County:						
P 790	American Falls	48		24			
P 236	Do	14		4	2		6
P 85 A	Do	9	2		8		18
	Owyhee County:						
R 3272	Enterprise	648					
R 3469	Oreana	1,344		280	312		
R 3470	Do	32		1,472	40		
	Shoshone County:						
P 161	Pierce	50		1,450			130
P 290 A through ½.	Do	10	6	62	28		
P 290 A through 2 on ½.	Do	1		12	11		
P 290 B through ½.	Do	4		106	24		
P 290 B through 2 on ½.	Do	Trace.		16	10		
P 291	Do	Trace.		Trace.			
P 293 through ½	Do	32		572	42		
P 293 through 2 on ½	Do	2		17	4		
R 3219	Do	24		1,806			
R 3205	Pierce City, district	72		1,360	320		
P 292	Do	.2		1,189		25.7	
P 280 A	Pierce City, Cow Creek	3		1,351	199		
P 280 B	Do	2		1,080	413		
R 3204	Delta	784			26	960	
R 3769	Rhodes Creek	48		1,376			
R 3390	Oro Grande Creek			1,192			
P 64	Near Dent	28	1,336		307		
P 303	Orofino	78		244	40		
	Washington County:						
P 25	Meadows	629	564		Trace.		
P 276	Do	.5		16	4		
P 235	Central Idaho, Salmon River	922		486	380	[c] 20	
P 114 through ½	Snake River sand	51		9	6		4
P 114 through 2 on ½	Do	48		7	4		6
R 3543	John Day Creek	288		104	972	8	
	INDIANA.						
R 3294	Morgan County, Centreton	168		1,280	208		
	La Porte County:						
R 3196	Michigan City	264		1	122	1,477	
P 13	Do	1,181	2		370		

[a] Includes a little garnet. [b] Includes pyrite.

the United States, by localities—Continued.

Monazite.	Limonite.	Zircon.	Quartz.	Unclassified.	Gold.	Platinum.	Gold and platinum.	Remarks.
Pounds per ton.	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Dollars per ton.*	*Dollars per ton.*	*Dollars per ton.*	
52					25.16			6 pounds rutile; 14 pounds per yard.
Trace.		30	760	160	1.86			100 lbs. per ton of gravel.
46		122	12		234.34			Concentration not known.
		Trace.	400	68	3.31	2.40		1,200 pounds per day.
			1,538	390	114.20			Taken from sluice box.
			1,488	488	.62			Natural sand.
			1,335	628	Trace.			Natural sand, old river channel.
				[a] 1,352			None.	6 pounds to yard.
		56					None.	1 pound to yard.
56			340	80	2.19			Concentration not given.
94		50	226		17.36			100 pounds per ton of gravel.
3		3	1,471	409	.66			Trace rutile; original gravel.
.1			1,766	207	.25			Tailings; original gravel.
Trace.		Trace.	1,528	338	.04			Do.
			1,800	174	.12			Trace titanite and rutile; tailings.
	24		1,306	24	1.06			Natural sand.
		46	832	474			0.41	Screened tailings from placer dump.
2			1,473	499			.06	Do.
30		30		90	854.28			10 pounds corundum, 10 pounds cinnabar, 1 pound per ton.
70		150		28	3.51	1.20		25 pounds per cubic yard of gravel.
81		14	654	33	77.14			Taken from sluice box.
46			300	93	12.04			7.8 pounds titanite, 18 pounds per cubic yard.
50		.6	358	96	22.45			3 pounds rutile; concentration not known.
				[b] 200	132.29	Trace.		Concentration not known.
Trace.		80	400	100	42.37			Trace of cinnabar, 120 pounds per ton gravel.
			232	576	19.15			2 pounds per cubic yard gravel.
283			45				No assay.	
6		2	1,440	190	.93			Natural sand.
123		392	232		9.64			2 pounds per ton.
.1		1	1,274	704	.66			Not concentrated.
		50	100	42	42.99			Concentration not known.
		2	1,432	493	1.12			Natural sand.
		1	884		.98			Do.
				628	74.62			40 pounds per ton of gravel.
			160	24	29.64			1 pound per 4 yards.
			90	6			None.	
34		66	344		.15			

[c] Titaniferous.

Mineral composition of various black sands of

Serial number.	Locality.	Magnetite.	Chromite.	Ilmenite.	Garnet.	Hematite.	Olivine.
	KANSAS.	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*
R 3167	Marshall County, Marysville						
	MARYLAND.						
	Baltimore County:						
P 482 through 20	Glyndon	2	2		Trace.	Trace.	
P 482 through 10	Do	4	2		Trace.	Trace.	
P 718	Do	428	678				
P 492	Harrisonville	354	152	48			
P 298	Ocean City, beach sand	Trace.		138	12		Trace.
	MISSISSIPPI.						
R 3138	Pike County, Magnolia						
	MONTANA.						
P 218	Beaver Head County, Wisdom	1,612		26		44	
R 3493	Choteau County, Fort Benton	304					
	Custer County:						
P 80 A	Miles City	11	.7		21		11
P 80 B	Do	7			2		121
P 147 A	Do	11	74		21		119
P 147 B	Do	7			2		122
P 489 A	Do	2		2	2		
P 489 B	Do	2		Trace	Trace.		
P 489 C	Do	2	2	2	2		
P 489 D	Do	Trace.	Trace.	Trace.	1		
P 489 E	Do	Trace.	Trace.	Trace.	Trace.		
P 489 F	Do	2		Trace.	2		
R 3213	Granite County, Princeton	1,952		10			
	Jefferson County:						
R 3972	Elk Horn	1,872		8			
R 3857	Beef Strait	1,600				200	
	Madison County:						
R 3416	Alder	800			650	200	
R 3335	Alder Gulch	216			320	1,250	
R 3880	Meagher County, Canyon Ferry	1,000			640	160	
	Missoula County:						
R 3291	Deer Creek sand	1,908	30		2	24	
R 3496	Quartz					1,800	
P 91	Powell County	1,779	17		128		
R 3550	Ravalli County, Alta					1,824	
P 204	Silver Bow County, Butte	1,776					
	NEBRASKA.						
	Seward County:						
R 3794	Milford						
R 3795	Do						
R 3796	Do						
R 3797	Do						
R 3798	Do						

[a] Includes manganese.

the United States, by localities—Continued.

Monazite.	Limonite.	Zircon.	Quartz.	Unclassified.	Gold.	Platinum.	Gold and platinum.	Remarks.
Pounds per ton.	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Dollars per ton.*	*Dollars per ton.*	*Dollars per ton.*	
			1,800	a 200			None.	
	Trace.					Trace.		Not concentrated.
	Trace.					0.19		Trace of cassiterite; not concentrated.
	12	Trace.				Trace.		Natural sand.
		2				.00		Do.
Trace.		19	1,816	15	0.21			Do.
		Trace.	2,000				None.	
		2	30	16	.21			268 pounds cassiterite; 2 pounds pyrite; concentrate.
			1,500	200	1.85			1 pound per cubic yard of gravel.
		2	1,266	578	.11			Natural gravel.
		8		1,868	Trace.			Do.
		2	1,266	578	.11			Do.
		8		1,868	Trace.			Do.
	6				Trace.			Do.
			1,794	200	.00			Do.
	2	Trace.			Trace.			Do.
	2	Trace.			.23			Do.
	Trace.	Trace.			.12			Do.
	16	Trace.					No assay.	Do.
6				32	34.52	1.50		Concentration not given.
			60	60			None.	4 pounds per cubic yard.
			100	100			None.	50 pounds per cubic yard.
			250	100	244.32			Dredge concentrates.
			124	100	118.65			1 pound per cubic yard of gravel.
			80	80			None.	
				5	1.45			21 pounds per cubic yard after amalgamation.
				200	160.81			Sluice box concentrates.
16.3		8			10.31			3 pounds per cubic yard.
			96	b 80	81.44			1 pound per cubic yard.
	224				55.81			Old channel, drifting, not concentrated.
				2,000			None.	Original sand.
				2,000	.41			Do.
Trace.				2,000	.62			Do.
Trace.				2,000			None.	Do.
	1,600		80	320			None.	Do.

b Includes cassiterite.

Mineral composition of various black sands of

Serial number.	Locality.	Magnetite.	Chromite.	Ilmenite.	Garnet.	Hematite.	Olivine.
	NEVADA.						
	Elko County:	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*
R 3548	Dixie Creek	880		112			
R 3791, No. 1	Mascot	296				560	
R 3818	Esmeralda County, near Silver Peak.	8					
R 3304	Nye County, Berlin	136					
	Ormsby County:						
P 35	Carson City	1,387	485		41		
P 75	Do	1,190	168		353		
	NEW MEXICO.						
	Grant County:						
R 3946	Pinos Altos	1,664			60	164	
R 3729	Do	1,680					
R 3669	Do	1,464		160		160	
R 3180	Lincoln County, Tecotote Mountains.	1,544		48			
	Otero County:						
P 232 A	Brice	212		30		218	
P 232 B	Do	578		14	2	412	
	Sandoval County:						
R 3231	Bernardillo	1,752				100	
R 3225	Do	1,888		70		12	
R 3212	Do	1,408		192		184	
R 3421, No. 2	Do	1,032			25	544	
	Santa Fe County:						
R 3623	San Pedro	16				16	
R 3420, No. 1	Golden	744				192	
R 3234	Los Cerrillos	1,088		325		350	
R 3362	From Tuer to Arroyo	1,352				224	
	Sierra County:						
R 3227	Shandon	832		400		500	
R 3671	Hillsboro	1,400				480	
	NEW YORK.						
	Lewis County:						
R 3276	Lowville	16		72			
R 3855	Rochester	1,744		24	24	56	
	NORTH CAROLINA.						
R 3634	Buncombe County, Morganhill.	24		1,848			
	OHIO.						
R 3513	Franklin County, Licking						
	OKLAHOMA.						
	Comanche County:						
R 3612	Springfield			160			
R 3613	Do	448		408			
R 3597	Sheridan district	100				120	
P 463	Dewey County, Putnam		Trace.		Trace.		

a Includes pyrite.

b Largely quartz.

the United States, by localities—Continued.

Monazite.	Limonite.	Zircon.	Quartz.	Unclassified.	Gold.	Platinum.	Gold and platinum.	Remarks.
Pounds per ton.	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Dollars per ton.*	*Dollars per ton.*	*Dollars per ton.*	
		Trace.	344	664	2.48			20 pounds per ton.
	960	Trace.		184	448.75			Trace of cinnabar; ½ pound per yard.
			1,500	492	.21			Natural sand.
		Trace.		1,864	65.32			20 pounds per ton.
29		21	9		7.44			Concentration not known.
5		80	5		8.78			12 pounds per ton.
			56	56	9.30			800 pounds per ton of gravel.
		48	200	172	1.65			1 pound per cubic yard.
				216	13.23			200 pounds per ton; sluicing.
				400			Trace.	
		16	1,098	340	40.10			86 pounds titaniferous hematite; 20 pounds per ton.
			708	286	377.43			$509.60 per ton by scorification assay, 2½ pounds per ton.
		16		a 132			None.	190 pounds per ton.
			10	20			None.	400 pounds per ton.
				b 916			None.	66 pounds per ton.
			350	49	1.65			30 pounds per ton.
			32	1,936	29.14			2 pounds per ton.
			394	680	4.13			50 pounds per ton.
Trace.		Trace.		237			Trace.	8 pounds per ton.
		Trace.		424	4.55			1½ pounds per ton.
5			263				None.	40 pounds per cubic yard.
	10		110		26.46			Concentration not given.
		Trace.		c 1,912	Trace.			Natural sand.
Trace.		24	24	96	16.33			Concentration not given.
			112	16	Trace.			4 pounds per cubic yard.
			1,500	500			None.	40 pounds per ton.
			1,000	840	Trace.			Concentration 1 to 3.
				1,144			None.	
			1,500	280			None.	60 pounds per ton.
		Trace.			1.03			Natural sand.

c Includes quartz.

Mineral composition of various black sands of

Serial number.	Locality.	Magnetite.	Chromite.	Ilmenite.	Garnet.	Hematite.	Olivine.
	OREGON.						
	Baker County:	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*
P 666 A	Durkee	72	2	720	8		
P 666 B	Do	Trace.		32			
P 666 C	Do	8	Trace.	32			
P 98	Do	486	868		308		119
P 84	Do	435	126		1,000		250
P 827	Do	898	62	736			
R 3075	Do	32	200	700			
R 3708	Anthony	1,688			40		
R 3391	Baker City	208		768			
R 3681	Huntington						
R 3359	Sumpter	208		864			
R 3784	Do	528	1,240				
R 3062	Sparta	400		500		700	
P 774	Rye Valley	1,412				[a] 218	
P 112	Richland	1,282		554	58		
P 212	New Bridge	990				988	
R 3741	Benton County, Alsea	464		528			
	Clatsop County:						
P 390	Astoria	11	2		23		50
P 164	Do	14	6		9		2
P 164	Do	16	6		8		14
P 6	Do	13	3		271		52
P 366 A	Do				.2		
P 366 B	Do	4	208	Trace.	Trace.		
P 32	Clatsop Beach	537	43		137		
P 821 A	Hammond	284		124	18		
P 821 B	Do	90					
P 821 C, 0′–30′	Do	26					
P 821 C, 30′–42′	Do	12					
P 821 C, 52′–64′	Do	10					
P 821 (mixed)	Do						
P 488	Near Seaside	4	Trace.	10	2		
P 700	Warrenton	6		2			
P 26	Gearhart Beach	1	.5		29		11
P 30	Warrenton	1,123	257		181		336
P 393 A	Hammond	160	1		65		451
P 393 B	Do	72	7		18		314
P 393 C	Do	299	22		90		264
P 378, No. 1	Do	1,187	145		428		184
P 378, No. 2	Fort Stevens	8	3		6		126
P 378, No. 3	Do	7	1		2		238
P 378, No. 4	Do	1	1		9		241
P 378, No. 5	Do	19	4		83		243
P 378, No. 6	Do	5	.5		89		251
P 378, No. 7	Warrenton	.8	.4		1		91
P 378, No. 8	Do	5	.7		2		461
P 7 (C.)	Do	2	1		1		203

[a] Titaniferous hematite.

the United States, by localities—Continued.

Monazite.	Limonite.	Zircon.	Quartz.	Unclassified.	Gold.	Platinum.	Gold and platinum.	Remarks.
Pounds per ton.	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Dollars per ton.*	*Dollars per ton.*	*Dollars per ton.*	
Trace.		24	518	656	1.86			Concentrates.
		Trace.	1,640	328			No assay.	Tailings.
Trace.		2	1,450	506	.10			Do.
		62	155		139.40			Concentration not known; from bedrock.
			187		2,325			Concentration not known.
		14		290			8.74	Do.
			90	998	204.63	6.60		6 pounds per ton.
		152	16	104	5.17			20 pounds per ton.
	72	Trace.		472	202.29			Contains cassiterite; ¼ pound per cubic yard.
			1,800	200	5.99			Natural sand.
		Trace.		920	1.45			Do.
		128		104	267.47			1 pound to 10 cubic yards of gravel.
			300	100	.41			Natural sand worked by sluicing.
		12	270	88	27.49			After amalgamation of sluice-box concentrates.
				106			No trace.	
				20			None.	Trace of cinnabar.
			88	920			None.	Natural sand.
1		.6	1,420	38	1.10			Do.
Trace.		.2	1,333	632			No trace.	Do.
Trace.		.5	1,413	540			None.	Do.
131		.1	639	888	.02			Natural sand from bottom of river.
		Trace.			.21			Country rock.
		Trace.			2.94			Indurated clay.
.4		.6	54				None.	Natural sand.
							.04	Do.
							No trace.	Do.
							.40	Do.
							.18	Do.
							.18	Do.
							No trace.	Do.
		Trace.	1,828	156			Trace.	Do.
		Trace.	1,530	458			Trace.	Do.
.1			1,672	285	.43			Do.
		5	92	2			No trace.	Do.
2		1	1,065	252	Trace.			Do.
1		47	1,193	344			No trace.	Do.
1		2	1,073	247	Trace.			Do.
1		9	43				.16	Do.
.2		5	1,410	440			Trace.	Do.
		3	1,539	208			None.	Do.
.3		4	1,319	422			None.	Do.
1		2	1,368	277			None.	Do.
		1	1,125	426			None.	Do.
		3	1,730	1,726			.03	Do.
.8		7	1,455	66			None.	Do.
.1		.2	1,488	293			.06	Do.

Mineral composition of various black sands of

Serial number.	Locality.	Magnetite.	Chromite.[a]	Ilmenite.	Garnet.	Hematite.	Olivine.
	OREGON—continued.						
	Clatsop County—Continued.	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*
P 7 (W.)	Warrenton	14	2		3		163
P 5 A	Hammond	62	24		30		563
P 5 B, No. 1	Do	643	171		174		
P 5 B, No. 2	Do	683	162		226		
P 5 B, No. 3	Do	666	173		149		218
P 5 B, No. 4	Do	782	195		127		
P 2 C, No. 1	Carnahan Station	4	.7		3		381
P 2 C, No. 2	Do	29	2		155		229
P 2 C, No. 3	Do	7	2		1		114
P 380	Seaside	.4	4		22		334
P 381	Do	.8	3		3		
P 389 No. 1	Between Seaside and Warrenton.	.3	.3		30		257
P 389 No. 2	Gearhart Park	.1	1		1		49
P 389 No. 3	Do	1	.1		7		401
P 389 No. 5	Clatsop	1	7		9		360
P 389 No. 6	Carnahan Station	.3	.1		1		400
P 389 No. 7	Do	2	1		22		210
P 389 No. 8	Morrison	Trace.	.9		3		340
P 389 No. 9	Do	1	1		2		120
P 389 No. 10	Warrenton	16	5		7		353
P 391 No. 1	Clatsop Spit, Columbia River.	14	1		37		375
P 391 No. 3	Do	3	.6		11		98
P 391 No. 4	Do	53	83		137		466
P 391 No. 5	Do	16	2		5		96
P 391 No. 6	Do	540	72		143		404
P 395 B	Elk Creek	2	8		16		227
P 395 C	Do	.1	2		2		207
P 392 A	Fort Stevens	36	5		11		563
P 392 B	Do	12	1		3		142
	Coos County:						
P 443	Marshfield	23	467		29		
P 444 A	Do						
P 444 B	Do						
P 731	Do	2	8	10			
P 375 through 8	Bullards	32	676	76	364		
P 375 through 2	Do	4	168	18	132		
P 61 A	South Fork Coquille River.	10	50		15		
P 61 B	Do	3	31				
P 102 A	Randolph district, beach sand.	11	45		2		.1
P 102 C	Do	22	216		698		219
P 102 D	Do	20	583		741		
P 102 E	Do	11	202		168		221
P 102 F	Do	29	893		382		171
P 102 G	Do	15	235		164		
R 3043	Do	48	1,500		300		
R 3044	Randolph district, Old Ocean Beach.	24	1,100		800		
R 3042	Randolph, old sea wall	24	200		1,600		

[a] Chromite in this column contains ilmenite.

the United States, by localities—Continued.

Monazite.	Limonite.	Zircon.	Quartz.	Unclassified.	Gold.	Platinum.	Gold and platinum.	Remarks.
Pounds per ton.	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Dollars per ton.*	*Dollars per ton.*	*Dollars per ton.*	
0.1	....	0.1	1,451	362	....	....	....	Natural sand.
1	....	.8	1,281	35	....	....	0.06	Do.
.8	....	5	335	524	....	....	Trace.	Do.
.9	....	5	288	483	....	....	.53	Do.
.4	....	6	362	345	....	....	Trace.	Do.
.7	....	4	237	365	....	....	Trace.	Do.
Trace.	....	.5	1,609	1	....	....	.12	Do.
Trace.	....	.1	1,571	12	....	....	.21	Do.
Trace.	....	.1	1,535	340	....	....	.08	Do.
1	....	1	122	408	0.25	....	....	Do.
1	....	.5	131	[b] 1,860	.01	....	....	Do.
.5	....	.3	1,644	66	....	....	No trace.	Do.
.4	....	1	1,650	295	.16	....	....	Do.
1	....	2	1,555	30	Trace.	....	....	Do.
2	....	2	1,616	Trace.	.09	....	....	Do.
.5	....	.1	1,460	136	.10	....	....	Do.
.5	....	.3	1,571	190	Trace.	....	....	Do.
.3	....	.2	1,383	272	....	....	....	Do.
.3	....	.6	1,528	346	....	....	....	Do.
1	....	.8	888	725	Trace.	....	....	Do.
.1	....	.6	1,235	335	....	....	None.	Do.
.2	....	.9	993	892	.05	....	....	Do.
.6	....	4	597	173	Trace.	....	....	Do.
.5	....	.3	1,308	570	Trace.	....	....	Do.
.2	....	2	670	166	.02	....	....	Do.
4	....	1	1,663	75	.04	....	....	Do.
.4	....	.4	1,720	67	Trace.	....	....	Do.
3	....	1	1,218	161	....	....	None.	Do.
.4	....	5	1,562	272	Trace.	....	....	Do.
....	....	36	1,200	243	2	....	....	570 pounds per ton.
....	....	....	....	....	1	....	....	Natural sand.
....	....	....	....	....	.71	....	....	Do.
....	....	2	....	....	Trace.	....	....	
....	....	44	670	....	....	....	72	Concentration not known; coarse.
....	....	10	1,322	346	....	....	3.08	Concentration not known; fine.
.4	....	12	1,757	....	....	....	....	Natural sand.
....	....	....	1,864	....	.11	....	....	Do.
1	....	6	.2	1,969	....	....	8.78	Pannings from sea beach.
.2	....	46	794	2	1.46	....	....	Do.
Trace.	....	45	240	368	....	....	None.	Pay streak (?) from Old Lane mine.
Trace.	....	16	1,378	Trace.	....	....	None.	Natural sand.
....	....	51	413	57	.56	....	....	Concentrates from sluicing.
....	....	22	1,295	265	....	....	28.70	Do.
Trace.	....	100	....	....	....	27.30	....	Concentration 200 to 1.
....	....	76	....	....	.41	3.00	....	Concentration 50 to 1 (supposed to be barren).
....	....	72	....	104	37.21	63.00	....	Concentration 100 to 1.

[b] Olivine not separated.

Mineral composition of various black sands of

Serial number.	Locality.	Magnetite.	Chromite.	Ilmenite.	Garnet.	Hematite.	Olivine.
	OREGON—continued.						
	Coos County—Continued.	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*
P 101	Whiskey Run	4	5	....	2	....	71
R 3277	Whiskey River	16	1,152	56	32	....	....
R 3078	Bandon Beach	200	1,000	300	....	....	....
P 92	Johnson Gulch	656	261	....	842	....	2.6
P 727	Lincoln County, Coos Bay	64	470	228	260	....	....
R 3567	Crook County, Howard	960	....	88	....	240	....
	Curry County:						
P 46	Gold Beach	584	82	....	295	....	67
P 86	Chetco	1,520	285	....	....	....	110
P 742	Ophir	....	....	....	....	....	....
P 87 A	Port Orford	26	24	....	197	....	217
P 87 B	Do	259	66	....	1,104	....	276
P 88	Port Orford beach	31 6	71	....	54	....	919
P 97	Rogue River beach	865	106	....	61	....	781
P 86	Near Pistol River	1,520	285	....	....	....	110
R 3398	Beach sand at Ophir	592	600	....	....	....	....
R 3565	Eckley	584	....	....	....	320	....
P 166	....	1.2	Trace.	....	.6	....	4
P 96	Cunett's Beach	83	56	....	1	....	....
	Douglas County:						
R 3193	Drain	1,344	....	272	....	....	....
R 3293	South Umpqua River	1,168	....	620	40	16	....
P 417	Steamboat River	1,618	....	180	....	36	....
R 3148	Rogue River	1,496	....	168	....	....	....
R 3061	Glendale	808	750	320	....	....	....
R 3222	Starvout	425	475	....	....	400	....
R 3958	Do	1,072	608	Trace.	....	....	....
R 3957, No. 3	Do	1,480	Trace.	....	....	....	....
R 3064	Riddles	850	700	40	....	240	....
R 3130	Do	464	1,168	304	....	....	....
	Grant County:						
R 3221	Copper	10	....	....	....	....	....
R 3353	Granite	184	1,528	....	....	....	....
R 3934	Do	1,880	....	....	....	56	....
R 3938	Vinson Creek	192	1,344	16	288	....	....
P 210	Big Creek	704	212	502	292	....	....
	Jackson County:						
P 650	Ashland	808	42	134	....	....	....
R 3843	Do	1,500	....	400	....	....	....
P 342	Wimer	1,536	116	956	....	....	....
R 3239	Do	504	480	736	....	....	....
P 62	Gold Hill	183	1,691	....	....	....	....
R 3215 A	Do	300	1,100	200	....	....	....

a Mostly pyrite.

the United States, by localities—Continued.

Monazite.	Limonite.	Zircon.	Quartz.	Unclassified.	Gold.	Platinum.	Gold and platinum.	Remarks.
Pounds per ton.	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Dollars per ton.*	*Dollars per ton.*	*Dollars per ton.*	
....	....	0.4	1,609	227	....	....	0.17	Natural sand from raised beach.
....	....	88	....	656	....	6.00	....	Concentration 5 to 1.
....	....	250	....	250	25.84	186.90	....	Concentration 75 to 1.
....	....	1	209	25	704.67	....	....	1 pound per 10 cubic yards.
....	....	54	868	58	....	....	2.27	Natural beach sand.
....	....	....	....	712	65.52	....	....	1 pound to 2 cubic yards.
0.5	....	5	524	529	....	....	.78	Natural beach sand.
....	....	4	54	24	.30	....	....	Do.
....	....	....	....	....	3.82	....	....	300 pounds per ton.
....	....	....	1,300	304	....	....	.30	Tailings after gold extracted from sluicings.
.1	....	3	289	....	....	....	.18	Do.
....	....	3	915	....	....	....	1.04	Natural sand.
....	....	2	182	....	....	....	None.	Do.
....	....	4	54	24	.30	....	....	Do.
....	....	....	500	292	378.26	1,022.10	....	2½ pounds per ton.
....	....	....	....	1,096	2,830.96	....	....	2 pounds from 5 yards of beach sand.
6	....	Trace.	1,917	71	.17	....	....	Ore.
....	....	8	....	....		....	None.	Natural sand.
....	....	....	....	384	3.72	.60	....	650 pounds per ton gravel.
....	....	5	....	10	3.51	....	....	Sluicing; concentration not known.
....	46	....	34	12	24.39	....	....	74 pounds of titaniferous hematite; 500 pounds per ton.
....	....	....	....	336	490.50	....		
....	....	....	100	22	10.34	67.50	....	Concentrates from hydraulic sluice; 2 pounds per yard.
....	....	....	200	500	45.27	....	....	1 pound 3 cubic yards.
....	....	....	288	32	58.50	....	....	Concentration not known.
....	....	....	....	520	15.50	....	....	Do.
....	....	....	....	170	97.36	257.70	....	4 pounds per day.
....	....	48	....	....	398.31	3,861.90	....	Heavy concentrates from hydraulic mine.
....	....	....	....	[a]1,990	70.84	....	....	Concentration not known.
....	....	8	....	164	....	....	None.	
....	....	24	40	....	50.64	....	....	Do.
....	....	....	100	70	48.37	....	....	1 pound per 4 cubic yards of gravel.
....	....	....	112	178	222.75	....	....	1 pound per 1 cubic yard of gravel.
....	....	4	268	552	18.19	....	....	Concentrated from cement of gravel.
....	....	....	....	100	9.51	....	....	Concentration not known.
....	....	8	....	....	297.56	....	....	1 pound per 80 cubic yards of gravel.
....	....	192	....	64	38.86	....	....	Sand from sluice of placer working.
....	....	2	91	31	82.68	....	....	Concentration not known.
Trace.	....	Trace.	....	400	....	....	None.	

Mineral composition of various black sands of

Serial number.	Locality.	Magnetite.	Chromite.	Ilmenite.	Garnet.	Hematite.	Olivine.
	OREGON—continued.						
	Jackson County—Continued.	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*
R 3494	Gold Hill	1,544		80	80		
P 19	Jacksonvile	1,463	a 296		Trace.		
P 106	Medford	408	1,159				
R 3275	Birdseye Creek	1,672	8				
R 3910	Foote Creek			1,912			
R 3528	Watkins	1,440	80	64			
	Josephine County:						
P 261 A	Josephine Creek, near Kerby.	1,285	145	.2		34	
P 92	Holland	656	261		842		2
P 159 A	Do	1	1				
P 159 B	Do	1	1	Trace.	1		82
P 167	Kerby	751	24		14		90
P 165	Do	1,533	174				
P 712	Galice	2		238			
R 3132	Do	1,128	312	176			
P 34	Sutler Creek	1,146	a 673				
P 67 A	Waldo	27	8		74		
P 67 D	Do	26	124		32		
P 68 A	Do	77	641		719		
P 68 B	Do		22				
P 95	Do	359	1,121				
P 194 A through ½.	Do	580				1,082	
P 194 A through 2 on ½.	Do	9				14	
P 194 B through ½.	Do	159				347	
P 194 B through 2 on ½.	Do	271		1	4	426	
P 194 C through ½.	Do	33			4	64	
P 194 C through 2 on ½.	Do	48				100	
P 194 D through ½.	Do	96	.2		Trace.	230	
P 194 D through 2 on ½.	Do	110				124	
R 3184	Do	480				1,272	
R 3312	Do	112	640			1,000	
R 3141	Do	64	1,752				
P 171	Sucker Creek	1,380	392	152			
R 3143	Do	1,040	624				
R 3807	Do	1,000	500			200	
P 18	Wolf Creek	392	90		690		31
R 3055	Do	288	1,100	8			
P 198	Placer	678	686	242			
R 3144	Coyote Creek	336	1,456				
R 3142	Green Back	456	1,336				
R 3311	Illinois River, near Kerby	1,688	160				
R 3832	Kerby district	28	136	56		28	

[a] Includes hematite.

the United States, by localities—Continued.

Monazite.	Limonite.	Zircon.	Quartz.	Unclassified.	Gold.	Platinum.	Gold and platinum.	Remarks.
Pounds per ton.	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Dollars per ton.*	*Dollars per ton.*	*Dollars per ton.*	
			200	100	53.74			2 pounds per cubic yard of gravel.
		4			74.00			Concentration not known.
			63	373	117.00			Placer clean-up.
Trace.				200	339.19			Concentration 1,000 to 1.
			24	64	27.90			Concentration not known.
			40	336	43.40			Do.
		.5	45	485			44.40	Ore.
		1.1	209	25	704.67			1 pound per 10 cubic yards of gravel.
			1,876	108	.35			Ore.
24			1,405	483			None.	Do.
		.2	92	1,027	5.16			Natural sand.
		.5	37	253	45.47			Placer sand.
			696	1,067			No assay.	Concentration not known.
			200	160		7.80		Do.
		24	11				275.91	Do.
			1,890				25.73	Sluice-box tailings.
		5	521	1,289			.25	
		.5	223	337			18.99	Concentrates from sluice box.
		28	371	1,596			.19	Natural sand.
		316	94	108			144.33	Concentration not known.
		.2	98	238			125.74	Pannings.
								Do.
			465	1,030			79.79	Placer concentrates.
		.2	36	1,256			217.45	Do.
		1	591	1,305			5.37	Rocker tailings.
		.1	360	1,492			5.99	Do.
		.4	36	1,636			96.74	Concentration not known.
		Trace.					128.98	Do.
			200	40	770.99	11.99		Do.
		Trace.	200	40	436.55	451.20		1 pound per cubic yard of gravel.
		30		106	38.86	135.90		1 pound per 15 cubic yards of gravel.
12		10	2	48			42.99	1 pound per 8 cubic yards of gravel.
				312	134.98	20.10		1 pound per 20 cubic yards of gravel.
				200	65.73			1 pound per 8 cubic yards of gravel.
.1		15	245	533			192.33	Concentration not known.
		128		12	52.09			Do.
46		28	184	136			61.60	Do.
				208		Trace.		2 pounds per cubic yard of gravel.
		120		80	326.79	191.40		Concentration 100 to 1.
				152	461.75	323.10		75 pounds per ton of gravel.
Trace.		4			10.75	32.10		Trace cinnabar. Concentration not known.

Mineral composition of various black sands of

Serial number.	Locality.	Magnetite.	Chromite.	Ilmenite.	Garnet.	Hematite.	Olivine.
	OREGON—continued.						
	Josephine County—Continued.	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton*	*Pounds per ton.*
P 439	Browntown	1,476				320	
	Lane County:						
R 3320	Cottage Grove	632					
R 3321	Do	48				1,920	
R 3322	Do	8					
	Lincoln County:						
P 274 A	Yaquina Bay	124	106	540	632		
P 274 A	Do	122	128	572	516		
P 274 B	Do	86	60	546	506		
P 732 A	Newport	160	136	662	484		
P 732 B	Do	6	12	26	54		
P 732 C	Do	42	58	192	132		
R 3240	Toledo	328	120	120	880		
	Linn County:						
P 73	Foster	1,238	600		71		
R 3242	Do	1,064		432		208	
P 239	Malheur County, Snake River	974		676	82		
R 3149	Marion County, southeast corner.	584		1,024			
	Multnomah County:						
P 197	Fulton	830		909			60
P 551	Latourelle, Columbia River sand.	66		24	6		
P 33	Do	52	[a] 312		768		360
P 181 A	Portland	46		10			
P 818	Portland (Glisan street)	2	Trace.	Trace.	Trace.		Trace.
P 70	Polk County, Fall City	217	612		739		852
R 3065	Tillamook County, Oretown	232	Trace.	1,100	100		
P 93	Umatilla County, Weston	981	688		113		36
R 3070	Union County, La Grande	850		100			
P 37	Wallowa County, Wallowa	50	9		175		
	Wasco County:						
P 28	Hood River, beach	995	[b] 174		221		287
P 122 A	Hood River, sand bar in	22	3		37		118
P 122 B	Hood River, Columbia River.	30	3		9		129
P 122 C	Do	135	19		39		339
P 82 B	Washington County, Hillsboro.	[b] 42					
P 407	Wheeler County, Antone	1,762	6	196			
P 90	Yamhill County, North Yamhill.	2		5			
P 816 K	Columbia River, Rogers bar, etc.	6		2	2		
	SOUTH DAKOTA.						
	Custer County:						
R 3279	Custer				1,700		
R 3159	Do				1,032		
	Lawrence County:						
P 284	Tinton	56		30			
P 192	Do	504		128	82	804	

[a] Includes ilmenite. [b] Includes hematite

the United States, by localities—Continued.

Monazite.	Limonite.	Zircon.	Quartz.	Unclassified.	Gold.	Platinum.	Gold and platinum.	Remarks.
Pounds per ton.	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Dollars per ton.*	*Dollars per ton.*	*Dollars per ton.*	
				58		48.30		Titaniferous hematite 146 pounds. Concentration not known.
				1,368	0.83			
			16	16			None.	
				1,992			None.	
		84	300	212	.62			Natural sand.
Trace.		78	256	330	.62			Do.
Trace.		48	478	276	.21			Do.
		106	60	394	Trace.			Do.
		6		1,894			None.	Do.
		38	876	664			16.33	Do.
		Trace.		552	3.72			25 pounds per ton of gravel.
0.1		.7	10				Trace.	Concentration not known.
				280	53.74	105.60		Do.
		134	52	82	37.00			4 pounds per ton of gravel.
			200	168			None.	20 pounds per ton of gravel.
.5		1	79	118			No trace.	Natural sand.
		Trace.			16.12			Concentration not known.
479		26			.16			Ore.
			1,438	480	26.87			Natural sand.
Trace.	Trace.	Trace.					None.	$1.65 per ton in first concentration.
.4		102	40	1	.34			Ore.
		Trace.		560			None.	Concentration, 5 to 4.
46		122	12		204.34			Concentration unknown.
				1,050	49.61	3.60		100 pounds per ton of gravel.
.7			630	610	2.25			Concentraton not known.
5		16						
.4		.4	1,182	634	.32			Natural sand.
.5		1	1,214	610	Trace.			Do.
1		1	1,048	411	.02			Do.
			1,096	861	3.40			Do.
2	2		12	20		1,560.00		Concentration unknown.
		Trace.			.03			Natural gravel.
		2	788	1,200			.19	Concentration not known.
			250	50	4.75			Do.
			760	200			Trace.	50 pounds per ton of gravel.
			1,313	524	.14			35.7 pounds cassiterite; 40 pounds apatite; tailings.
6		20	288	80	22.74			66 pounds cassiterite; 20 pounds dolomite; concentration not known.

Mineral composition of various black sands of

Serial number.	Locality.	Magnetite.	Chromite.	Ilmenite.	Garnet.	Hematite.	Olivine.
	SOUTH DAKOTA—continued.						
	Lawrence County—Continued.	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*
R. 3580	Tinton	1,776		40			
P. 282 A	Bear Creek, near Tinton	120		16	110		
P. 282 B	Do	76					
R. 3666	Hurricane district	1,360		80		168	
R. 3713	Bear Butte district						
	Pennington County:						
R. 3952	Sheridan				1,888		
R. 3579	Keystone	192					
R. 3786	Rochford				1,900		
R. 3949	Do	1,976					
R. 39[illegible]8	Rockerville	16			768	Trace.	
R. 35[illegible]9	Do				1,400		
R. 3290	Pactola	104			1,080	760	
R. 3245	Big Horn Mountains	1,040	8			504	
	TEXAS.						
R. 3984	Llano County, Llano	104					
R. 31[illegible]8	Hardeman County, Red River		112	1,400		256	
	UTAH.						
R. 3292	Garfield County, Hite	800		32	24	1,032	
R. 3547	Iron County, Sand Springs					512	
R. 3206	Morgan County, Morgan	1,136		104		100	
R. 3171	Piute County, Marysvale	240		Trace.		640	
R. 3346	San Juan County, junction Comb wash and San Juan Rivers.	544		672	24	676	
	Uinta County:						
P. 72 A	Green River, Gensen district.	848	677		300		
P. 72 B	Do	1,532	321		78		
R. 3872, No. 1	Do	1,080				736	
R. 3872, No. 2	Near Gensen	936			272	488	
	WASHINGTON.						
	Asotin County:						
P. 626 A	Snake River sand	34		18	8	Trace.	
P. 626 B	Do	20	Trace.	12	6		
P. 626 C	Do	30	Trace.	16	4		
R. 3386, No. 1	Do	256					
R. 3386, No. 2	Do	936		512			
R. 3860	Do	900		150	600		
P. 1[illegible]9 B	Clarkston	572		530	274		
P. 135	Chehalis County, Oyhut	8	4	53			118
	Chehalis County:						
P. [illegible]79	Damons Point, Grays Harbor.	474		689	154		412
P. 134 B	Joe Creek, Grays Harbor	100		162	498		418

the United States, by localities—Continued.

Monazite.	Limonite.	Zircon.	Quartz.	Unclassified.	Gold.	Platinum.	Gold and platinum.	Remarks.
Pounds per ton.	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Dollars per ton.*	*Dollars per ton.*	*Dollars per ton.*	
			56	24	27.08			104 pounds cassiterite; old tailings.
			128	268	19.22			1,216 pounds cassiterite; 50 pounds tantalite; 90 pounds scheelite; pannings.
				228	4.13			1,612 pounds cassiterite; 50 pounds tantalite; 34 pounds scheelite.
		20		572	13.23			
			1,900	100	1.03			Concentration 2 to 1.
		Trace.	32	80	.62			1½ pounds per cubic yard of gravel.
				1,808	5.17			Concentration not known.
				100	9.10			80 pounds per ton of gravel.
				24			None.	
			1,200	16	105.00			1 pound per 2 cubic yards of gravel.
			528	72	3.72			4½ pounds per cubic yard of gravel.
				60	47.75			400 pounds per ton of gravel.
448		Trace.			23.98			150 pounds per ton of gravel.
				1,896	1.24			Concentration 3 to 1.
			200	32	1.45			50 pounds per ton of gravel.
Trace.		72	24	16	131.46	4.50		Concentration not known.
		Trace.	1,472	16	6.61			480 pounds per ton of gravel.
		Trace.		660			Trace.	165 pounds per ton of gravel.
			48	1,064	Trace.			4 pounds per ton of gravel.
		8		70	2.07			
25.4		120	22		100.33			3 pounds per yard of gravel.
2		43	16		339.98			Do.
		176		8	1,040.94			2 pounds per yard of gravel.
		96	96	112	47.54			3 pounds per yard of gravel.
		2			1.64			Natural sand.
		Trace.			.19			Do.
		2			.12			Do.
			760	992	3.72			22 pounds per ton of gravel.
Trace.		16		536	13.23			18 pounds per ton of gravel.
Trace.		50		300	.39			Concentration, 100 to 1.
		30	370	224	24.99			Concentrated by panning.
Trace.			1,330	487	.72			Natural sea beach sand.
		43	89	134			0.05	Do.
		15	788	16			Trace.	Do.

Mineral composition of various black sands of

Serial number.	Locality.	Magnetite.	Chromite.	Ilmenite.	Garnet.	Hematite.	Olivine.
	WASHINGTON—continued.						
	Chehalis County—Continued.	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*
P 133	Moclips, Grays Harbor	72	24	82	...	...	1,597
P 132	Cow Point, Hoquiam	12	12	...	4	...	6
P 132	Do	8	2	...	4	...	22
R 3865	Clallam County, Shi-Shi beach.	40	...	1,120	424	...	...
	Clark County:						
P 209 m	Camas	90	...	1,282	20	2	...
R 3329	Brush Prairie	1,176	...	328	320	...	...
R 3419	Canyon Creek	1,726	...	...	...	200	...
P 639	Douglas County, Columbia River.	1,414	150	188	...	...	...
P 692	Garfield County, Pomeroy	426	...	298	36	Trace.	...
	King County:						
P 434	Auburn	Trace.	...	Trace.	...	...	...
P 524	Fort Canby	296	...	36	...	...	...
P 525	Near Fort Canby	172	...	12	2	...	Trace.
P 83	Kittitas County	1,643	188	...	118	...	...
R 3700	Liberty	112	...	...	120	...	...
R 3431	Do	900	...	...	500	100	...
R 3589	Cle-Elum district	1,568	272	...	...	...	...
R 3169	Lincoln County, Davenport	664	...	...	24	...	
R 3463	Okanogan County, Similkaneem Falls.	1,664	...	152	...	160	...
	Pacific County:						
P 529	Nahcotta	2	...	2	Trace.	...	...
P 530	Oysterville	2	...	8	6	...	...
P 531	Leadbetter Point	74	8	76	36	...	...
P 532	Ocean Park	22	...	4	...	...	...
P 533	Sand Island	160	...	68	10	Trace.	...
P 534	Beards Hollows	436	...	524	4	2	...
P 535	Fort Canby	822	...	240	20	...	...
	Skagit County:						
P 338 through ½	Anacortes	1	1,137	...	...	...	...
P 338 through ½	Do	...	715	...	...	...	...
R 3983	Snohomish County, near Silverton.	952	280	...	...	320	...
	Stevens County:						
P 220	Newport	2	...	...	...	...	...
R 3635	Marcus	1,096	...	56	432	...	...
R 3201	Wilmot Bar, Columbia River.	1,308	...	150	272	...	...
	Thurston County:						
P 660 A	Bucoda	4	...	4	...	...	...
P 660 B	Do	8	...	2	2	...	...
R 3915	Lime water	728		...	...	...	...
P 250	Wahkiakum, Sand Island, Columbia River.	54	16	...	32	...	130
	Whatcom County:						
P 697	Excelsior	2	Trace.	...	Trace.	Trace.	...
P 78	Bellingham	[a]1,978	...	...	2	...	...
P 79	Do	...	...	...	...	...	...

[a] Includes hematite.

the United States, by localities—Continued.

Monazite.	Limonite.	Zircon.	Quartz.	Unclassified.	Gold.	Platinum.	Gold and platinum.	Remarks.
Pounds per ton.	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Dollars per ton.*	*Dollars per ton.*	*Dollars per ton.*	
71.5		10	12	122			0.17	Natural sea beach sand.
			434	1,530			.02	Do.
		.4	438	1,528			.02	Do.
Trace.		96		120	558.09	613.50		
		2	384	218	1.34			Concentration not known.
Trace.		Trace.		176	57.05			
			74		Trace.			
6		24	84	132	30.59			13 pounds per cubic yard gravel.
		72					17.36	Concentration not known.
	6						No assay.	Trace siderite; natural sand.
			60	1,608			No assay.	Natural sand.
	30		996	786			No assay.	Do.
			5.5	45	315			25 pounds per ton of gravel.
			1,500	268	2.69			2 pounds per cubic yard of gravel.
			1.400	100	896.66			Concentration not known.
				160	530.81			4 pounds per cubic yard of gravel.
			1,200	112	59.12			25 pounds per cubic yard of gravel.
		8		16	31.42			110 pounds per cubic yard of gravel.
					Trace.		Trace.	Natural sand.
		Trace.					No trace.	Do.
		6					Trace.	Do.
		Trace.					.87	Do.
		2					1.51	Do.
		4				.58		Do.
Trace.		Trace.	396	520			.81	Do.
				859			.14	Do.
				1,282			.41	Do.
				448	11.58			Ore.
			1,608	366			No trace.	24 pounds mica; natural gravel.
Trace.			344	72	12.61			5 pounds per cubic yard of gravel panned.
30		60	50	30	1.65			
		Trace.					.21	Natural sand.
		Trace.					62	Do.
		Trace.	1,000	270			None.	
			1,108	658	.06			Natural sand.
		Trace.			.62			Trace pyrrhotite; tailings.
			18.3		Trace.			Ore.
	1,427			573	Trace.			Pyrite and iron phosphate; ore.

Mineral composition of various black sands of

Serial number.	Locality.	Magnetite.	Chromite.	Ilmenite.	Garnet.	Hematite.	Olivine.
	WASHINGTON—continued						
	Whatcom County—Continued.	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*
P 113	Bellingham	7			1		1
R 3598	Mount Baker district	1,568		176	Trace.		
P 148	Yakima County, Mabton	50		2			
P 141	San Juan Island, Guemes	17	1,735				
	WYOMING.						
	Albany County:						
P 663 A	Sherman	24		14	20	Trace.	
P 663 B	Do	Trace.		Trace.	Trace.		
P 447	Douglas Creek	606		304		1,090	
R 3913	Do	304		784	540		
P 792	Laramie, New Rambler mine.	166	Trace.	4		Trace.	
R 3861	Keystone	232		784	Trace.	744	
R 3679	Do	32				1,600	
R 3531	Big Horn County, Shoshone River.	48					
R 3875, No. 1	Carbon County, South French Creek.	272					
	Crook County:						
P 432 A	Sand Creek and Spotted Tail Creek.	1,536				12	
P 432 B	Do	1,422					
	Fremont County:						
R 3303	Atlantic City	56		608		800	
R 3521	Strawberry, Ducktown gulch.	408	80	344	88	752	
R 3283	South Pass City	1,304			96	360	
R 3694	Do	1,360				320	
	Johnson County:						
R 3970, No. 1	Buffalo	1,016		80			
R 3685, No. 1	Do	944		240		480	
R 3904	Sheridan County, Sheridan	1,816				48	
	Sweetwater County:						
P 662 A	Green River	22		8	10		
P 662 B	Do	158		66	34	2	
P 662 C	Do	30		16	12		Trace.
R 3942	Uinta County	400			240		
P 110 A	Bald Mountain district	1,931		29			
P 110 B	Do	5	1.2		17		1
P 215	Dot Island, Yellowstone Lake	10		2			
	CANADA.						
	British Columbia:						
P 21	North Thompson River	561	218		818		
R 3216	Atlin	800	50	300			
R 3868	Hall Creek, Nelson district	1,400				288	
P 60		10	3		9		
P 709	Saskatchewan River, Crooked Creek.	16		24	16	Trace.	
P 63 A	Saskatchewan River	823	351		178		1
P 63 C	Do	119	670		494		11

the United States, by localities—Continued.

Monazite.	Limonite.	Zircon.	Quartz.	Unclassified.	Gold.	Platinum.	Gold and platinum.	Remarks.
Pounds per ton.	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Dollars per ton.*	*Dollars per ton.*	*Dollars per ton.*	
		0.1	1,502	487	Trace.			
				256	50.43			
			882	1,066	.23			
		1.5	10.5	235			No assay.	
		Trace.			.19			Trace of galena.
					Trace.			
					780.71			Concentration not known.
				372	54.36			1 pound per cubic yard of gravel.
	112					0.41		
	Trace.	240			52.92	123.30		3 pounds per cubic yard of gravel.
			120	248	259.40			5 pounds per ton of gravel.
				1,952	1.03			Concentration, 2 to 1.
	240		400	1,088	1.45			Placer concentrates.
			94	316			13.33	34 pounds cassiterite; 10 tantalite.
				578			10.66	Sluice box concentrates.
		Trace.		536	Trace.			14 pounds per ton of gravel.
				228	227.99			1½ pounds per 5 tons of gravel.
		Trace.		300	226.48			50 pounds per ton of gravel.
			168	15	13.02			Do.
		80	824				None.	8 pounds per ton of gravel.
		Trace.	200	136	234.19			Concentration not known; sluicing.
				136			None.	
		Trace.			None.			Natural sand.
Trace.		10			.82			Do.
		2			None.			Do.
			448	912	23.15			Concentration, 75 to 1.
2		37	.8		.32			Concentrated in sluice.
2		3.6	1,592	376	.25			Not concentrated.
			646	1,342	Trace.			
13		20			230.78			Concentration not known.
				550	196.16			300 pounds cassiterite; concentration, 1,000 to 1.
				312	112.57			Concentration not known.
1		1	1,635		.31			
	4	4			2.48			
.6		133	429	82	15.86			Tailings from sluice.
1		14	688		17.78			Do.

Mineral composition of various black sands of

Serial number.	Locality	Magnetite.	Chromite.	Ilmenite.	Garnet.	Hematite.	Olivine.
	CENTRAL AMERICA.	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*
P 768	Costa Rica	1,654	....	90	....	[a] 118	96
R 3953	Honduras, Trujillo	720	....	1,080	....	....	....
R 3956	Do.	72	....	1,120	400	....	....
R 3955	Do.	204	....	1,088	320	....	....
	SOUTH AMERICA.						
P 325	United States of Colombia, Taragoza.	8	14	1,484	....	....	....

[a] Titaniferous.

the United States, by localities—Continued.

Monazite.	Limonite.	Zircon.	Quartz.	Unclassified.	Gold.	Platinum.	Gold and platinum.	Remarks.
Pounds per ton.	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Pounds per ton.*	*Dollars per ton.*	*Dollars per ton.*	*Dollars per ton.*	
....	....	6	12	24	0.62	....	....	Concentration not known.
....	....	160	....	30	....	....	None.	
....	....	....	160	250	1.86	....	....	
Trace.	....	240	....	150	....	....	None.	
Trace.	....	302	192	....	....	....	No assay.	

In various instances no mineral separation was carried out, and only assays were made as to gold and platinum, the results of which are given in the following table:

Assays of small samples of concentrates from various localities.

[Containing one ounce or more of gold per ton or containing platinum.]

Serial number.	Locality.	Gold.	Platinum.
	ALASKA.	*Dollars per ton.*	*Dollars per ton.*
	Nome:		
R 3822, No. 2	Portland bench	340.02	
R 3823, No. 1	Do	1,008.70	
R 3824, No. 3	Do	393.28	
R 3824, No. 2	Do	793.73	
R 3826, No. 1	Do	515.65	
R 3826, No. 2	Do	3,077.69	
R 3881, No. 2	Near Nome, Mojave claim	42.17	
	ARIZONA.		
R 3759	Maricopa County, Phoenix	130.84	
	CALIFORNIA.		
R 3430	Amador County, Defender	56.22	
R 3133	Butte County, Empire	1.65	Trace.
	Calaveras County:		
R 3739	Murphy	45.26	
R 3762	Do	82.20	
R 3601 A	Fresno County, Shaver	273.26	
R 3418	Nevada County, Washington	26.46	
R 3077	Placer County, Gold Run	777.42	263.40
R 3183	Plumas County, Beckwith	Trace.	Trace.
R 3630	San Diego County, Banner	740.40	
	Shasta County:		
P 593	Stella	[a] 90.12	
R 3670	Do	90.12	
P 606	Siskiyou County, Dunsmuir	[a] 38.03	
	Trinity County:		
R 3134	Big Bar	101.21	138.30
R 3080	Trinity Center	47.75	
P 593	Boulder Creek	82.54	
	COLORADO.		
R 3650 B	Boulder County, Jamestown	163.29	
R 3106, No. 3	Clear Creek County, Georgetown	99.04	
	Gilpin County:		
R 3512	Central City	21.70	
R 3511	Do	33.90	
	Lake County:		
R 3339	California mining district	17.98	
R 4038, No. 2	Twin Lakes	97.17	
R 3121, No. 1	Saguache County, Pole Creek	1,282.57	
R 3348	San Miguel County, Ophir	24.37	
	IDAHO.		
	Bingham County:		
R 3566	Ammon	20.88	
R 3244	Thomas	25.63	
R 3258	Boise County, Garden Valley	63.04	

[a] Average.

Assays of small samples of concentrates from various localities—Continued.

Serial number.	Locality.	Gold.	Platinum.
	IDAHO—continued.	*Dollars per ton.*	*Dollars per ton.*
	Idaho County:		
R 3445	Florence	21.91	
R 3059	Lucile, Salmon River	11,120.00	144.00
R 3081 C	Lemhi County, Salmon	20.67	
R 3351	Nez Perce County, Orofino	146.96	
	MONTANA.		
	Madison County:		
R 3331	Virginia City	478.51	
R 3336, No. 3	Do	40.24	
R 3336, No. 2	Do	4,377.49	
R 3336, No. 1	Do	36.79	
R 3367	Missoula County, Oregon Gulch deposit	38.86	
R 3620	Granite County, Philipsburg	482.23	
	OREGON.		
	Baker County:		
R 3170	Sparta	85.57	
R 3079	Durkee	498.78	
R 3079 A	Durkee, Burnt River	182.52	
R 3075	Durkee	40.86	
R 3408 A	Greenhorn	108.58	
	Coos County:		
P 879 A	Coquille	119.46	
P 879 D	Do	44.85	
R 3228, No. 2	Douglas County, Bohemia mining district	Trace.	Trace.
R 3426	Jackson County, Foots Creek	243.69	
	Josephine County:		
R 3553	Grants Pass	19.57	27.00
R 3278	Holland	23.98	
R 3035	Browntown	7,682.00	
R 3175	Myrtle Creek	21,702.33	
R 3732	Marion County, Detroit	106.67	
	SOUTH DAKOTA.		
R 3839	Lawrence County, Custer	37.62	
	WASHINGTON.		
	Okanogan County:		
R 3457	Wehesville	21.08	
R 3734	Chesaw, Myers Creek district	73.38	
P 76	Skamania County, Texas Gulch	150.68	
R 3983, No. 1	Snohomish County, Sultan River	87.43	
	WYOMING.		
R 3582	Albany County, Jelm Mountain	30.45	
P 656 H	New Rambler mines	26.68	
P 656 I	Near Laramie	43.20	
R 3313	Fremont County, Lewiston	123.54	
	MEXICO.		
	Sonora:		
R 3836, No. 2	Cananea:	525.00	
R 3836, No. 1	Do	128.98	

Later investigations at Portland developed many assays for gold where the presence of platinum was suspected. The buttons resulting from these assays were sent to Messrs. Baker & Co., of Newark, N. J., who made an elaborate investigation of the metals contained. The results are given in the following table, which shows the percentages of platinum and iridosmium in the assay buttons from the localities indicated:

Percentage of platinum and iridosmium in assay buttons, by localities.

[Analyzed by Messrs. Baker & Co.]

Sample No.	Locality.	Weight received.	Platinum recovered.		Iridosmium recovered.	
	ALASKA.	*Grams.*	*Grams.*	*Per cent.*	*Grams.*	*Per cent.*
P 109	Yukon Territory, Dominion Creek.	0.2193	None.		None.	
	CALIFORNIA.					
P 270	Butte County, Nimshew	.3157	Trace.		0.0031	0.98
P 124	Humboldt County, Orleans	1.1262	0.0163	1.44	.0502	4.45
	Nevada County:					
P 260	Rough and ready	.6522	None.		None.	
P 260	Do	.2328	.0042	1.80	.0019	.81
P 260	Do	.9289	.0062	.66	.0027	.29
P 260	Do	.2170	.0050	2.30	.0053	2.44
	Plumas County:					
P 556	La Porte	.8847	.0102	1.15	.0013	.14
P 556	Do	1.5292	.0034	.22	Trace.	
P 95	Sacramento County, Sacramento	.1934	Trace.		None.	
	San Luis Obispo County:					
P 487	Point Sal	1.0100	Trace.		Trace.	
P 487	Do	.4915	.0137	2.78	.0011	.22
P 487	Do	.3563	.0009	.25	.0077	2.16
	Siskiyou County:					
P 168	Callahan	.5205	.0021	.40	.0059	1.13
P 168 A	Do	.4444	None.		Trace.	
P 168	Do	.5220	Trace.		Trace.	
P 569	Trinity County, Trinity Center	.1182	.0427	36.12	.0038	3.21
	COLORADO.					
P 117	Ouray County, Ouray	1.0922	.0129	1.18	.0493	4.51
	IDAHO.					
	Ada County:					
P 114	Boise	.1002	Trace.		Trace.	
P 365	Payette	.1804	.0017	.94	.0202	11.19
	Bingham County:					
P 369	Rich	.0627	.0004	.63	None.	
P 369	Do	8.3530	.0204	.24	.0106	.12
P 369	Do	.3855	.0027	.70	None.	
P 275	Blaine County, Wapi	.3687	.0008	.21	.0010	.31
	Boise County:					
P 657 A	Centerville	.5260	None.		None.	
P 655 A	Granite Creek district	1.3045	Trace.		Trace.	
P 655 A	Do	1.0141	.0011	.18	Trace.	
P 466	Elmore County, 20 miles from Boise	.9800	.0167	1.69	.0065	.66
	Idaho County:					
P 294	Elk City	.4362	Trace.		None.	
P 294	Do	.7788	None.		None.	
	Shoshone County:					
P 292	Pierce City	.3766	.0017	.45	.0004	.1
P 292	Do	1.2308	.0075	.61	.0008	.06

Percentage of platinum and iridosmium in assay buttons, by localities—Continued.

Sample No.	Locality.	Weight received.	Platinum recovered.		Iridosmium recovered.	
	OREGON.	*Grams.*	*Grams.*	*Per cent.*	*Grams.*	*Per cent.*
P 84	Baker County, Baker City	0. 2341	0. 0006	0. 25	0. 0001	0. 04
	Coos County:					
P 443	Marshfield	. 0073	. 0015	20. 54	None.	
P 102 A	Bullards	. 1914	. 0087	4. 54	. 0020	1. 04
P 102 C	Do	. 1375	. 0076	5. 52	. 0021	1. 52
P 102 E	Do	. 2669	. 1476	55. 3	. 0381	14. 28
P 102 G	Do	5. 4670	1. 1549	21. 12	. 7979	14. 59
P 102 G	Do	1. 1860	. 1413	11. 91	. 0910	7. 67
	Curry County:					
P 47	Gold Beach	. 1208	None.		None.	
P 47	Do	. 2100	None.		None.	
P 47	Do	. 1809	None.		None.	
P 636	Port Orford	2. 3331	. 1155	4. 95	. 2292	9. 82
	Jackson County:					
P 62	Gold Hill	1. 1814	. 0050	. 42	. 0042	. 35
P 106	Medford	. 2065	. 0057	2. 76	. 0011	. 53
	Josephine County:					
P 18	Coyote Creek	. 2131	. 0014	. 15	. 0115	5. 39
P 129 A	Galice	. 3444	. 0056	1. 61	. 0006	. 17
P 129 B	Do	5. 4500	. 0921	1. 69	. 2036	3. 73
P 129 D	Do	. 9229	. 0161	1. 74	. 0058	. 62
P 129	Do	9. 2938	. 0347	. 37	. 0038	. 04
P 183	Do	6. 1245	1. 1473	18. 73	1. 1905	19. 43
P 92	Holland	1. 3100	None.		None.	
P 92	Do	. 8078	None.		None.	
P 165	Kerby	. 2865	. 0089	3. 10	. 0408	14. 24
P 194 A	Waldo	10. 6000	. 0475	. 45	. 0008	. 007
P 194 A	Do	. 1560	. 0013	. 83	None.	
P 194 B	Do	. 8441	. 0096	1. 13	. 0024	. 28
P 194 B	Do	. 2096	None.		None.	
P 194 D	Do	1. 6270	None.		Trace.	
P 69	Do	. 1672	. 0078	4. 66	. 0001	. 05
P 68	Do	. 3520	. 1340	38. 06	. 0493	14
	Lincoln County:					
P 274	Yaquina Beach	. 4000	. 0036	. 9	. 0107	2. 67
P 274	Do	. 1446	. 0009	. 62	. 0025	1. 72
P 286	Columbia River	. 3541	. 0016	. 45	. 0275	7. 76
P. 20	Multnomah County, Portland	. 0860	. 0023	2. 67	. 0013	1. 51
	UTAH.					
P 72	Green River, Gensen district	. 2142	. 0006	. 28	None.	
	WYOMING.					
P 662 A	Sweetwater County, Green River	. 2784	. 0009	. 32	. 0007	. 25

NOTE.—See also table of proportions of platinum metals by Dr. Waldron Shapleigh on page 54, Bull. U. S. Geol. Survey No. 193, 1902, by J. F. Kemp; also Trans. Am. Inst. Min. Eng., vol. 33, 1900, p. 702.

MINERALS FOUND.

Omitting quartz, as normally present, the minerals found during the investigations were as follows, in order of frequency:

Minerals.	Specific gravity.	Minerals.	Specific gravity.
Magnetite	5.16–5.18	Apatite	3.17–3.23
Gold (native)	15.6–19.3	Titanite	3.4 – 3.65
Ilmenite	4.5 – 5	Manganese ores	3 – 4.82
Garnet	3.15–4.3	Copper	8.8 – 8.9
Zircon	4.7	Cinnabar	8 – 8.2
Hematite	4.9 – 5.3	Cassiterite	6.8 – 7.1
Chromite	4.3 – 4.6	Tremolite	2.9 – 3.1
Platinum (including arsenides)	14 –19	Tourmaline	2.98–3.2
Mercury	13.6	Lead (shot, etc.)	11.37
Amalgam	13.75–14.1	Wolframite	7.2 – 7.5
Feldspar	2.5 – 2.9	Siderite	3.83–3.88
Epidote	3.2 – 3.5	Corundum	3.95–4.10
Olivine	3.2 – 3.6	Josephinite (awaruite)	8.1
Pyrite (chalcopyrite, arsenopyrite, pyrrhotite)	4.9 – 6.2	Topaz	3.4 – 3.65
Monazite	4.9 – 5.3	Scheelite	5.9 – 6.1
Limonite	3.6 – 4	Molybdenite	4.7 – 4.8
Iridosmium	19.3 –21.12	Fluorite	3 – 3.25
Rutile	4.18 – 4.25	Columbite and tantalite	5.3 – 7.3
Pyroxene	3.2 – 3.6		

METHODS OF CONCENTRATION.

By R. H. Richards.

SANDS.

The sands were of six kinds: Sea sand, river sand, hydraulic tailings, gold dredge tailings, placer clean-up sands, and gold dredge clean-up sands. The sea sands especially considered were those from along the coast of Oregon; they consisted of quartz grains intermingled with which were grains of magnetite, ilmenite, chromite, garnet, hypersthene, olivine, monazite, zircon, gold, the platinum metals, and other minerals in greater or less quantity. The predominance of the dark-colored minerals accounts for the name. The sea beaches near the mouths of the rivers are especially rich, the heavy minerals having been concentrated by the natural action of the waves.

The sands from the rivers of Oregon also received especial attention. They were of much the same character as the sea sands, except that heavy minerals were apt to be present in less proportion.

Beside Oregon sands, samples of both sea sands and river sands were received from all parts of the United States.

A word on the hydraulic working and the dredging of gold-bearing gravels will serve to define the sands and gravels from these sources which were examined.

Hydraulic working.—The hydraulic method of working auriferous gravels, with or without the "giant" (powerful jet of water), delivers a stream of water and gravel to the upper end of a long set of sluice boxes which have riffle blocks along the bottom. As the water and gravel rush along, the heavy grains of gold, platinum, magnetite, and other heavy minerals settle into the crevices or riffles between the blocks. The gravel, which has been deprived of most of its values and heavy grains, goes off the lower end of the sluices, and in this paper is called "hydraulic tailings."

When the periodical time for cleaning up comes the water and gravel are shut off, the riffle blocks are lifted out, the gold and black sand are washed down into a tank, and most of the gold is saved by panning in gold pans with or without mercury. The black sand which is thrown away still contains some gold and perhaps platinum metals, and with them are also other heavy minerals of more or less commercial value. This black sand is called "placer clean-up tailings."

Dredging.—Dredging for gold is done by excavating a pit 100 feet by 120 feet, more or less, and floating in it a boat about 80 feet long and 36 feet wide. The boat has an enormous bucket elevator at the bow for digging and lifting the gravel, a screen with holes about ⅜-inch in diameter for screening the gravel, a stacker or elevator in the stern for lifting and piling up the bowlders and pebbles larger than ⅜-inch diameter, a set of 12 gold-catching tables with cocoa matting and expanded metal to serve as riffles and to catch the gold, and a pair of tail sluices for depositing the fine gravel from the tables from the stern of the boat. This fine gravel in this paper is called the "dredge tailing." When the clean up comes the tables and sluices are all cleaned off, and the gold is saved by means of a hydraulic classifier called an "octopus" and a gold miner's pan. The black sand that is rejected, still containing a little gold and perhaps platinum, together with other heavy minerals of more or less commercial value, is thrown away. This sand is here called "dredge clean-up tailings."

The sands were divided into three classes: Class 1, river and sea sands; class 2, hydraulic and dredge gravel tailings, and class 3, placer and dredge clean-up sands. The method used was practically the same with all three classes, except that it required more steps in the process for class 3 than for class 2 and more for class 2 than for class 1.

MACHINES USED IN THE EXAMINATION OF THE SANDS.

Screens.—Screens were used in series, namely, with 8-mm. holes, 2-mm. holes, and ½-mm. holes, which gave 4 sizes, as follows: The oversize of 8 mm., of 2 mm., of ½ mm., and the undersize of ½ mm.

Hydraulic classifier.—The hydraulic classifier, which treats sands by passing them over a succession of vertical tubes, each with a rising current of water, the earlier with a stronger current than the later, was tried and was found to have value on the coarser placer clean-up sands, all the gold of which was found in the first 3 spigots of a 24-spigot classifier. On the other hand, the very fine scaly gold of the sea sands was found to concentrate but little in the earlier spigots of the classifier, and since the placer sands are in small lots and are well treated by the process about to be described this machine was not adopted as a part of the process in the Geological Survey work.

Hand jig.—A hand jig was tried upon the coarser sizes of sands of classes 2 and 3 and was found to be very effective in separating the heavier portions from the lighter. The jig was therefore adopted as a part of the system of treatment. Its special field lay in the sizes between 8 mm. and 2 mm. In working the clean-up sands of class 3 the jig yielded a top layer containing the light useless pebbles which were easily skimmed off and thrown away. The bottom layer, on the other hand, carried scrap iron, gold nuggets, iron ore, and any other heavy minerals contained in the gravel. The gold from this layer can be picked out by hand or saved by the bottle and sodium amalgam process to be described later. The other heavy minerals can be separated from one another in the dried table concentrates by the Wetherill magnet.

Wilfley table.—The Wilfley table and the others derived from it, namely, the Pinder, the Woodbury, and the Christonsen, all have certain principles in common; the first three have taper riffles with diagonal ends; and all four tables give a jerking motion to throw the grains, a little at a time, toward the concentrates end. This agitation also causes the heavy concentrates to settle down on the surface of the table between the riffles, while the lighter waste sands are in suspension above them; thus the transverse current of wash water can move the latter toward the tailings side, while the former are moving toward the concentrates end. In this way the grains are spread out in fan form arranged mainly according to specific gravity, but partly also according to size.

As is pointed out by Mr. Henry E. Wood, of Denver, the free gold and platinum follow very near the upper margin of the heaviest concentrates. If one saves all of the heavy minerals on the first treatment and then retreats these concentrates, setting aside 4 or 5 inches of sand next the heaviest edge, the second concentrates so saved will contain practically all the gold and platinum. After separating from these second concentrates the gold and platinum, the two products, concentrates and tailings, from this second run can be dried and treated by Wetherill magnet for all the heavy minerals.

Pinder table.—The Pinder table differs from the Wilfley in that it is round, with circular riffles, ending in a spiral curve. The spiral ends of the riffles on the Pinder table have the same effect as the diagonal ending of those on the Wilfley. One of the advantages claimed for the Pinder table is the great length of riffles and therefore of treating surface. The surface is concave conical, with the water flowing from the circumference toward the center.

Woodbury table.—The Woodbury table differs from the Wilfley in having a rubber top completely covered with very fine riffles; it also has the larger riffles with diagonal ends. The fine riffles have the advantageous effect of spreading out the concentrates over the whole end.

Christonsen table.—The Christonsen table has a cam spring and bumping post, with wide and deep longitudinal riffles, and it gives a bump instead of a vanning jerk. The concentrates ends of these riffles slope upward toward the discharge ends, and each has its own little water jet. The heavy sand is jerked up against these streams of water and yields a series of productions graded largely according to the specific gravity of the minerals. The upper is heavier. The table is claimed to have very large capacity.

Wetherill magnet.—The Wetherill magnet (Rowand type) has a magnetic pole with sharp edge above the traveling feed belt, and a blunt pole directly under it. Both poles are capable of being magnetized by an electric current, which produces a condition varying from weak magnetism to intensely strong magnetism. The concentration of magnetism at the sharp edge causes all the grains to jump to the upper pole; and a cross belt running rapidly takes off these grains and deposits them in a bin, while the nonmagnetic grains go on with the belt. A series of such poles, each stronger than the one before it, takes off a series of magnetic products, each more weakly magnetic than the one before it. The magnet used in Portland had a belt 6 inches wide and rectangular pole pieces 5 by 6 inches. It took off magnetite when using 0.2 amperes of current; ilmenite with 1.1 amperes; chromite with 1.6 amperes; garnet with 1.75 amperes; hypersthene and olivine with 2.2 amperes; monazite with 3.5 amperes. Zircon was left behind with the gold as nonmagnetic. The platinum began to be lifted by the weakest current; most of it was lifted by a current of 1.5 amperes; iridium and iridosmine were left with the gold as nonmagnetic. The several products of the Wetherill magnet often need further cleaning on a Wilfley table. On a small scale this was done at the pavilion by gold pan, or batea.

The method of combining the Wilfley table and the Wetherill magnet to produce the results obtained was devised by Mr. Henry E. Wood, of Denver. The amperes indicated by him were somewhat modified, and the figures finally adopted were those which were found most satisfactory by Mr. Harmon Morse, who had charge of the Wetherill concentrator. The size of the screen and the complete tree of the process were worked up on the spot by the writer.

The action of the Wetherill magnet upon the minerals in the sands is shown in the following table:

Action of the Wetherill magnet on minerals found in placer sands together with their specific gravity.

Nonmagnetic.		Separated by current of ½ ampere or less.		Separated by current of 2 amperes.		Separated by current of 3.5 amperes.	
Iridium	22						
Iridosmine	19						
Electrum	15.6-19.3						
Gold	15.6-19.3						
Platinum	14 -19	Platinum		Platinum		Platinum	
Amalgam	14						
Mercury	13						
Lead	11						
Cinnabar	8.1						
Galena	7.5						
Wolframite	7.2- 7.5	Cast iron	7.5				
Cassiterite	7	Josephinite	7			Cassiterite (occasionally)	7
Scheelite	6			Hematite	5		
Crocoite	6						
Columbite	5.3- 7.3						
Pyrite	5	Magnetite	5.2	Ilmenite	5	Monazite	5
Molybdenite	4.8						
Zircon	4.7						
Barite	4.3- 4.6			Chromite	4.3-4.6	Pyrrhotite	4.5
Corundum	4			Rutile	4.2	Corundum	4
Cyanite	3.6			Limonite	4	Brookite	4
Diamond	3.5			Garnet	3 -4		
Topaz	3.5			Pyroxene	3.2-3.6		
Fluorite	3.25			Epidote	3.5	Spinel	3.5-4
Apatite	3.2			Titanite	3.5		
Spodumene	3.1						
Beryl	2.7			Chrysolite	3.3		
				Tourmaline	3		
				Siderite	3		
				Serpentine	2.5		

This list is only suggestive, as it needs to be corroborated on many samples of each species.

In order to study in detail the action of this magnet upon various minerals, representative specimens were obtained. When not already in the form of sand, they were ground to pass through a sieve of 30 meshes to the inch and to remain on a sieve of 150 mesh. The separator already described was set for the current strengths noted in the following tables, with a distance of 0.12 inch between the pole and the surface of the belt. The results are comparative only for this particular machine.

Action of Wetherill separator on minerals from black sands.

PLATINUM FROM JOSEPHINE COUNTY, OREG. (P. 49[a].)

Current.	Weight.	Per cent extracted.	Cumulative per cent.
Amperes.	*Grams.*		
0.15	0.606	4.0710	4.0710
.20	.269	1.8070	5.8780
.50	.260	1.7470	7.6250
.75	.082	.5509	8.1759
1.00	.210	1.4110	9.5869
1.25	.218	1.4650	11.0519
1.50	.258	1.7340	12.7859
1.75	.156	1.0480	13.8339
2.00	.973	6.5370	20.3709
2.25	.272	1.8280	22.1989
2.50	.452	3.0370	25.2359
2.75	.254	1.7060	26.9419
3.00	.200	1.3440	28.2859
3.25	.217	1.4580	29.7439
3.50	.044	.2956	30.0395
3.75	.048	.3225	30.3620
4.00	.052	.3493	30.7113
[b] 4.00	10.314	69.2600	99.9713

CHROMITE FROM NEW CALEDONIA. (P. 38.)[c]

0.15	0.064	0.0146	0.0146
.25	.003	.0007	.0153
.50	.014	.0032	.0185
.75	.040	.0092	.0277
1.00	.041	.0094	.0371
1.25	23.361	5.3440	5.3811
1.50	177.155	40.5200	45.9011
1.75	158.380	36.2100	82.1111
2.00	76.441	17.4900	99.6011
2.25	.112	.0256	99.6267
2.50	.055	.0126	99.6393
2.75	.690	.1579	99.7972
3.00	.044	.0101	99.8073
3.25	.004	.0009	99.8082
4.00	.082	.0188	99.8270
[b] 4.00	.635	.1453	99.9723

[a] Serial number.
[b] Tailings.
[c] From Baltimore Chrome Works.

Action of Wetherill separator on minerals from black sands—Continued.

CHROME IRON ORE, FROM WILLOWS, COLUSA COUNTY, CAL. (P. 16.) [a]

Current.	Weight.	Per cent extracted.	Cumulative per cent.
Amperes.	*Grams.*		
0.15	0.899	0.4194	0.4194
.25	.350	.1632	.5826
.50	.115	.0536	.6362
.75	.209	.0974	.7336
1.00	5.480	2.5570	3.2906
1.25	51.358	23.9500	27.2406
1.50	100.154	46.6900	73.9306
1.75	38.195	17.8100	91.7406
2.05	7.714	3.5980	95.3386
2.25	.296	2.2701	95.6087
2.50	.579	1.1380	95.7467
2.75	.707	.3298	96.0765
3.05	.518	.2416	96.3181
3.25	1.142	.5327	96.8508
3.50	.829	.3864	97.2372
3.75	1.226	.5719	97.8091
4.00	.481	.2244	98.0335
[b] 4.00	4.220	1.9680	100.0015

ALMANDINE GARNET, FROM MINERVA, ESSEX COUNTY, N. Y. (P. 17.)

Current.	Weight.	Per cent extracted.	Cumulative per cent.
0.15	1.284	0.7537	0.7537
.25	.063	.0370	.7907
.50	.191	.1121	.9028
.75	.331	.1943	1.0971
1.00	.576	.3381	1.4352
1.25	33.381	19.5900	21.0252
1.50	102.584	60.1600	81.1852
1.75	31.217	18.3200	99.5052
1.90	.161	.0945	99.5997
[b] 1.90	.681	.3996	99.9993

MONAZITE, FROM BRAZIL. (P. 45.)

Current.	Weight.	Per cent extracted.	Cumulative per cent.
0.15	0.030	0.0054	0.0054
.25	.035	.0063	.0117
.50	.035	.0063	.0180
.75	.090	.0161	.0341
1.00	.450	.0806	.1147
1.25	1.310	.2347	.3494
1.50	4.154	.7440	1.0934
1.75	6.966	1.2480	2.3414
2.00	21.175	3.7920	6.1334
2.25	159.180	28.5000	34.6334
2.55	118.548	21.2300	55.8634
2.75	77.198	13.8300	69.6934
3.00	94.697	16.9600	86.6534
3.25	16.405	2.9380	89.5914
3.50	13.235	2.3700	91.9614
3.75	4.069	.7290	92.6904
4.00	3.388	.6068	93.2972
[b] 4.00	37.246	6.6710	99.9682

[a] From the California Exhibit at the Lewis and Clark Exposition.
[b] Tailings.

Action of Wetherill separator on minerals from black sands—Continued.

ZIRCON CRYSTALS. (P. 44.) [a]

Current.	Weight.	Per cent Extracted.	Cumulative per cent.
Amperes.	*Grams.*		
0.15	0.881	0.7026	0.7026
.25	.085	.0677	.7703
.50	.171	.1395	.9098
.75	.307	.2447	1.1545
1.00	.370	.2950	1.4495
1.25	.335	.2671	1.7166
1.50	.875	.6977	2.4143
1.75	1.452	1.1320	3.5463
2.00	1.600	1.2760	4.8223
2.25	.681	.5430	5.3653
2.50	.427	.3405	5.7058
2.75	.460	.3668	6.0726
3.00	.215	.1714	6.2440
3.25	.189	.1508	6.3948
3.55	.087	.0693	6.4641
3.75	.117	.0933	6.5574
4.00	.105	.0837	6.6411
[b] 4.00	117.122	93.4000	100.0411

WOLFRAMITE, FROM GREAT WESTERN MINE, BOULDER COUNTY, COLO. (P. 22.)[c]

0.15	2.950	1.2520	1.2520
.25	.171	.0725	1.3245
.50	.277	.1176	1.4421
.75	.287	.1218	1.5639
.95	.491	.2084	1.7723
1.25	23.751	10.0800	11.8523
1.50	54.787	23.2500	35.1023
1.80	36.595	15.5300	50.6323
2.05	17.480	7.4160	58.0483
2.25	7.845	3.3300	61.3783
2.55	4.969	2.1090	63.4873
2.75	5.160	.1900	65.6773
3.00	.996	.4228	66.1001
3.25	.729	.3094	66.4095
3.50	.891	.3782	66.7877
3.75	.597	.2534	67.0411
4.00	1.770	.9458	67.9869
4.00	75.891	32.2100	100.1969

[a] Exhibit of Eimer and Amend, Lewis and Clark Exposition.
[b] Tailings.
[c] Exhibit of Colorado at the Lewis and Clark Exposition.

Action of Wetherill separator on Minerals from black sands—Continued.

COLUMBITE. (P. 43.)[a]

Current.	Weight.	Per cent extracted.	Cumulative per cent.
Amperes.	*Grams.*		
0.15	0.078	0.0851	0.0851
.25	.010	.0109	.0960
.50	.031	.0338	.1298
.75	.034	.0371	.1669
1.00	.142	.1550	.3219
1.30	20.025	21.8500	22.1719
1.50	20.320	22.1800	44.3519
1.75	16.854	18.4000	62.7519
2.00	8.575	9.3630	72.1149
2.25	3.789	4.1360	76.2509
2.50	.871	.9508	77.2017
2.75	.284	.3100	77.5117
3.00	.340	.3712	77.8829
3.25	.147	.1604	78.0433
3.50	.250	.2729	78.3162
3.75	.080	.0873	78.4035
4.00	.091	.0993	78.5028
[b] 4.00	19.690	21.5000	100.0028

JOSEPHINITE, JOSEPHINE CREEK, OREGON. (P. 14.)

0.15	104.395	97.450	97.450
.25	.270	.252	97.402
.50	.535	.500	98.202
.75	.477	.446	98.648
1.00	.235	.219	98.867
1.30	.422	.394	99.261
1.50	.134	.125	99.386
1.75	.205	.192	99.578
2.00	.144	.134	99.712
2.25	.047	.044	99.756
2.50	.037	.035	99.791
2.75	.073	.068	99.859
3.00	.021	.020	99.879
3.25	.005	.005	99.884
3.50	.007	.007	99.891
3.75	.004	.004	99.895
4.00	.004	.004	99.899
4.00	.068	.063	99.962

[a] Exhibit of Eimer and Amend at the Lewis and Clark Exposition.
[b] Tailings.

Greased plate.—A greased plate coated with petroleum grease about the consistency of vaseline was tried on the sands and was found to catch a certain portion of the grains; but, although this plate on examination appeared to leave the quartz out, it did not catch all the heavy minerals, nor did it have a selective value in separating heavy minerals into kinds. It was not therefore adopted.

Amalgamated copper plate.—An amalgamated copper plate was tried with sodium amalgam and was found to be efficient in catching the fine scaly gold of the seashore sand. The experiment was not carried far enough to ascertain whether an amalgamated, silver-plated copper plate would be better than the revolving bottle or barrel, or whether the cost of the sodium would be a serious bar to its use.

METHODS OF TESTING SANDS.

Assaying sands by sodium amalgam.—The ordinary fire assay for gold is made on very small quantities, one assay ton weighing 29.166 grams of sand being the usual weight employed, and when the sand carries from 1 to 40 cents of gold per short ton it would by this assay be reported to contain a trace of gold. This statement is so indefinite that it was wholly unsatisfactory for this investigation. Two plans were open—one was either to increase the weight of sand from 29.166 grams to, perhaps, 1,000 grams or more and the crucible furnace and cupels all in proportion, or to multiply the number of crucibles and cupels so as to treat the increased weight. The difficulty would lie in the excessive cost of the assaying, both as to materials used and as to time consumed. The second plan was to revolve endwise for an hour a 2-gallon bottle containing 1,000 grams of sand, a little water, and 50 grams of mercury, to which a bit of sodium as large as two peas had been added. The bottle was easily held in a wooden box screwed to a flange revolving about 50 times a minute on the end of a shaft. This test gave results of great accuracy on free gold, even if it was rusty. The test breaks down and fails only when the gold is completely covered over with some other material, as proved to be the case in certain samples from Grants Pass, Oregon, where the gold was coated with hematite. In this case the material should be ground finer to liberate the gold, so that the mercury can catch it. It also fails, of course, when the time of treatment extends beyond the oxidation of the sodium; hence at Portland the results obtained were revised by fire assay. Where the samples were low grade, these fire assays were carried out by fusions of 5 assay tons.

Platinum metals have a very curious relation to mercury. So long as the sodium amalgam is rich in sodium they amalgamate perfectly, but as soon as the sodium is spent the platinum metals leave the amalgam and refuse to remain combined with it. This property will prove of value in cleaning the platinum metals, for they can at first be separated from the sand with the gold, and then, by simply standing in water, the gold and platinum amalgam parts into gold amalgam and free platinum grains, which can easily be separated in the pan. The indications are that this property may be used for commercial separation as well as for assay, if the sodium does not make the expense too high.

The clean-up barrel or barrel amalgamator used in the California stamp mills may prove suitable for the treatment on the commercial scale with sodium amalgam.

Some form of revolving drier will probably prove most satisfactory for drying Wilfley concentrates preparatory to their treatment on the Wetherill magnet.

Batea.—The batea was used for panning the samples to see, in the first place, if they contained gold, platinum, or any of the valuable heavy minerals. Secondly, it was used to give a final cleaning to the various Wetherill concentrates. It is very effective for cleaning the heavy minerals, but it is sometimes troublesome in regard to very fine gold and platinum, from the fact that the grains, unless special care is taken, may be carried over in the interstices of the wood from one sample to the next, and in this way produce false results.

Gold pan.—The gold pan is very effective for this work.

Gold pan with riffles.—The gold pan with riffles on one side proved of great assistance in saving the mercury and amalgam from the bottle test. The mercury stayed in the riffles with great ease, allowing the sand to be washed away.

SCHEMES FOR EXAMINATION OF BLACK SAND.

The choice depends on kind of sand and size of sample, subject to which conditions the following suggestions are made:

Kind of sample.	Size of sample.	Tree number recommended [see next table].
Fine concentrates, small quantity	2 pounds, more or less	1
Fine concentrates, large quantity	10 pounds to 15 tons	2
Fine tailings, small quantity	2 pounds, more or less	1
Fine tailings, large quantity	10 pounds to 15 tons	2
Coarse concentrates, small quantity	100 pounds, more or less	7
Coarse concentrates, large quantity	1,000 pounds to 15 tons	8
Coarse tailings, small quantity	100 pounds, more or less	7
Coarse tailings, large quantity	1,000 pounds to 15 tons	8
Fine little lots	2 pounds, more or less	1
Fine large lots	10 pounds to 15 tons	2
Coarse little lots	2 pounds, more or less	7
Coarse large lots	10 pounds to 15 tons	8

Brief trees for examination of black sands.

Tree number.

1. Bottle, pan, Wetherill (free amalgamated gold).
2. Table, [a] bottle, pan, Wetherill (free amalgamated gold).
3. On 8-millimeter sieve, hand pick (free amalgamated gold located).
   On 2-millimeter sieve, bottle, pan.
   On ½-millimeter sieve, bottle, pan.
   Through ½-millimeter sieve, bottle, pan, Wetherill.
4. On 8-millimeter sieve, hand pick (free amalgamated gold located).
   On 2-millimeter sieve, jig, bottle, pan.
   On ½-millimeter sieve, table, bottle, pan.
   Through ½-millimeter sieve, table, [a] bottle, pan, Wetherill.
5. Grinder, bottle, pan, Wetherill (free and including amalgamated gold).
6. Grinder, table, bottle, pan, Wetherill (free and including amalgamated gold).
7. On 8-millimeter sieve, hand pick (free and including amalgamated gold located).
   On 2-millimeter sieve, bottle, pan, grinder, bottle, pan, Wetherill.
   On ½-millimeter sieve, bottle, pan, grinder, bottle, pan, Wetherill.
   Through ½-millimeter sieve, bottle, pan, Wetherill.
8. On 8-millimeter sieve, hand pick (free and including amalgamated gold located).
   On 2-millimeter sieve, jig, bottle, pan, grinder, table, bottle, pan.
   On ½-millimeter sieve, table, bottle, pan, grinder, table, bottle, pan, Wetherill.
   Through ½-millimeter sieve, table, [a] bottle, pan, Wetherill.

[a] The first concentrates, if not rich, are re-run on table, making No. 1 and No. 2 concentrates.

The tree of the process recommended for commercial work on the three classes of sands in large lots is as follows: (Tree No. 8 of the table amplified.)

Sand.

8 mm. screen.

Undersize. Oversize.

Class 1, waste.
Class 2, waste or treated like 3.
Class 3, hand picked for heavy minerals.

2 mm. screen.

Undersize. Oversize.

Class 1, waste.
Class 2, waste or treated like 3.
Class 3, jigged, concentrates hand picked, or amalgamated and treated by Wetherill magnet.

½ mm. screen.

Undersize. Oversize.

Class 1, waste.
Class 2, waste or treated like 3.
Class 3, Wilfley table, concentrates amalgamated and treated by Wetherill magnet.

Wilfley table.

Concentrates. Tailings.

Waste.

Wilfley table.

Better concentrates. Poorer concentrates.[a]

Revolving bottle. Same treatment as the better concentrates.

Sodium amalgam.

Residue. Sodium, amalgam, gold, and platinum.

On small scale dissolved in nitric acid, leaving gold and platinum metals on large scale retorted.

Dry.

Wetherill magnet 0.2 amperes.

Residue. Magnetites.[b]

For electric steel furnace.

Wetherill, 0.8 amperes.

Residue. Ilmenite.[b]

Ilmenite for electric companies.
Source of titanium.
In certain cases chromite.

Wetherill, 1.75 amperes.

Residue. Garnet.[b]

For abrasive.

Chromite.[b]

For chemist and steel maker.

Wetherill, 1.90 amperes.

Residue. Hypersthene.

Waste.

Wetherill, 3.5 amperes.

Zircon[b] (little quartz.) Monazite[b]

For Welsbach burner mantels. For Welsbach burner mantels.

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[a] Should the gold be encased in some other mineral and therefore can not be amalgamated, these two products should be ground finer to free the gold, and the amalgamation repeated.

[b] Each of these six minerals may needa little cleaning on the Wilfley table before being shipped.

RESULTS OF CONCENTRATION.

In the following tables are grouped the results thus far completed in the effort to separate, by shaking tables, the precious metals from very heavy sands:

Lots in which a high per cent of the gold and platinum material was concentrated into a small bulk.

Record number.	Locality from which sample was obtained.	Material.[a]	Quantity.	Actual value of gold and platinum in product.	Percentage of value saved.
	CANADA.		*Pounds.*		
P 709	Canada	Concentrates 1 and 2	1$\frac{9}{32}$	\$0.04	66.66
		Tailings	49$\frac{1}{16}$		
	ALASKA.				
P 490 through ½	Through Seattle	Concentrates 1	17.5	1.45	93.5
		Tailings and concentrates 2.	139.5	.06	3.9
	CALIFORNIA.				
	Butte County:				
P 675	Oroville	Concentrates 1 and 2	209	.85	100
		Tailings	24,340		
P 744 B through ½	Gold Bluff	Concentrates 1	20	.02	66.66
		Tailings and concentrates 2.	150	.01	33.33
P 744 B through 2 (Pinder).	Do	Concentrates 1	2.5	.02	100
		Tailings and concentrates 2.	197.5		
P 744 B through 2 (Wilfley).	Do	Concentrates 1	4.66	.03	[b] 100
		Tailings and concentrates 2.	333.34	.006	20
P 744 C through 2	Do	Concentrates 1	7.5	.06	75
		Tailings and concentrates 2.	214.5	.01	12.5
P 744 D through 1	Do	Concentrates 1	15.31	1.11	72.6
		Tailings and concentrates 2.	197.69	.10	6.2
P. 740	Humboldt County, Trinidad.	Concentrates 1	4$\frac{10}{16}$	.03	75
		Tailings and concentrates 2.	56.6	.01	25
P 620	Los Angeles County, Ocean Park.	Concentrates 1	211	9.88	99.7
		Tailings and concentrates 2.	11,801	.01	.1
P 168 B through ½	Siskiyou County, Callahan.	Concentrates 1 and 2	13	2.03	68.4
		Tailings	132.5	.11	3.7
	COLORADO.				
	Chaffee County:				
P 491 A	Buena Vista	Concentrates 1	31	.12	100
		Tailings and concentrates 2.	66		
P 491 B	Do	Concentrates 1	26	.02	
		Tailings and concentrates 2.	49.5		
	IDAHO.				
P 365 through 2 on ½.	Ada County, Payette	Concentrates 1	.33	.12	75
		Tailings	890.25	.03	18.8
P 369	Bingham County, Rich	Concentrates 1 and 2	15.25	6.34	94.6
		Tailings	494.75	.45	7

[a] In this series of tables concentrates 1, 2, and 3 are synonymous with the first, second, and third products on the Wilfley and other tables.
[b] Concentrates showed more than the original sand.

Lots in which a high per cent of the gold and platinum material was concentrated into a small bulk—Continued.

Record number.	Locality from which sample was obtained.	Material.	Quantity.	Actual value of gold and platinum in product.	Percentage of value saved.
	IDAHO—continued.		*Pounds.*		
P 655 B	Boise County, Placerville.	Concentrates 1 and 2	14.5	$0.15	100
		Tailings	80.5		
P 294 through ½	Idaho County, Elk City	Concentrates	3	.39	97.5
		Tailings	17	.01	2.5
	Lincoln County:				
P 839 A	Minidoka, Snake River sand.	Concentrates 1	8.6	.15	100
		Tailings and concentrates 2.	3,841.5		
P 839 B	Do	Concentrates 1	6.9	.11	100
		Tailings and concentrates 2.	2,165		
P 839 C	Do	Concentrates 1	15 10/16	.11	100
		Tailings and concentrates 2.	1,675 6/16		
P 114 through ½	Snake River sand	Concentrates 1 and 2	21.5	.39	100
		Tailings	673.5		
	Nez Perce County:				
P 283 through ½	Dent	Concentrates 1	3.5	.28	96.6
		Tailings and concentrates 2.	26.5	.01	3.4
P 626 D	Lewiston	Concentrates	52	1.81	83.7
		Tailings and concentrates 2.	923	.18	8.3
P 627	Clearwater River, near Lewiston.	Concentrates 1	6.6	.02	100
		Tailings and concentrates 2.	13.4		
	Shoshone County:				
P 291	Pierce City	Concentrates 1 and 2	11.5	.09	100
		Tailings	5.5		
P 292	Do	Concentrates 1	9	1.06	98.1
		Tailings and concentrates 2.	19	.02	1.9
P 280 A	Cow Creek, Pierce district.	Concentrates 1	9.5	.25	73.5
		Tailings and concentrates 2.	47	.09	26.5
P 280 B	Do	Concentrates 1	17	.31	96.9
		Tailings and concentrates 2.	11.5	.01	3.1
	OREGON.				
P 666 A	Baker County, Durkee	Concentrates 1	10.5	.21	80.8
		Tailings and concentrates 2 and 3.	271.5	.01	3.8
P 366 B	Clatsop County, Astoria.	Concentrates 1 and 2	12	.13	100
		Tailings	76.5		
P 444 B	Coos County, Marshfield.	Concentrates	2.5	.01	100
		Tailings	34.5		
P 194 C through 2 on ½.	Josephine County, Waldo.	Concentrates 1 and 2	13.75	.31	88.5
		Tailings	103.5		
P 90	Yamhill County, North Yamhill.	Concentrates 1 and 2	10.5	.02	100
		Tailings	1,380.5		
P 165	Josephine County, Illinois River, near Kerby.	Concentrates	38	1.83	100.5
		Tailings	42	.03	1.5
	SOUTH DAKOTA.				
P 284	Lawrence County, Tinton	Concentrates 1	2	.001	100
		Tailings	10.75		

Lots in which a high per cent of the gold and platinum material was concentrated into a small bulk—Continued.

Record number.	Locality from which sample was obtained.	Material.	Quantity.	Actual value of gold and platinum in product.	Percentage of value saved.
	WASHINGTON.				
	Chehalis County:		*Pounds.*		
P 179	Damons Point	Concentrates 1	360	$0.07	87.5
		Tailings and concentrates 2.	2,746		
P 132 A	Cow Point, Hoquiam	Concentrates 1	19.5	.01	100
		Tailings and concentrates 2.	1,375.5		

Lots in which a high per cent of gold and platinum was saved, but the concentrates are too large in quantity, or there is some imperfection in the assays not yet located, or both.

Record number.	Locality from which sample was obtained.	Material.	Quantity.	Actual value of gold and platinum in product.	Percentage of value saved.
	CALIFORNIA.		*Pounds.*		
P 270	Butte County, Minshew	Concentrates 1 and 2	50	$2.37	86.4
		Tailings	25	.19	6.9
P 100 B	Del Norte County, Smith River.	Concentrates 1 and 2	90	.012	11.35
		Tailings	50		
P 487	San Luis Obispo County, Beach sand.	Concentrates 1 and 2	476.25	3.14	87.9
		Tailings	1,993.75	.43	12
P 27 A	Yuba County, Marysville.	Concentrates 1	132	.145	91.8
		Tailings and concentrate 2.	195	.012	7.6
	IDAHO.				
P 275	Blaine County, Wapi	Concentrates 1	35.5	.38	52.7
		Tailings and concentrates 3.	506.5	.34	44.4
	Boise County:				
P 654 through 2 on ½	Idaho City	Concentrates 1 and 2	156	94.61	83.5
		Tailings	275	18.70	16.5
P 771	Centerville	Concentrates 1 and 2	17.6	4.27	97
		Tailings	17.2	.28	6.4
P 277	Grimes Creek near Centerville.	Concentrates	18	.11	68.75
		Tailings	24	.05	31.25
P 654 through ½	Idaho City	Concentrates	310	99.73	78.5
		Tailings	380	27.30	21.5
P 114 through 2 on ½.	Snake River sand	Concentrates 1 and 2	15.5	.05	62.5
		Tailings	157	.03	37.5
P 294 through 2 on ½.	Idaho County, Elk City	Concentrates	14	3.28	99.7
		Tailings	10		
	OREGON.				
P 342	Jackson County, Wimer	Concentrates	7.2	2.52	83.2
		Tailings	13.3	.53	16.8
	Josephine County:				
P 167 B	Kerby	Concentrates 1 and 2	261.5	3.03	96.8
		Tailings	748.5	.42	13.4
P 194 B through ½.	Waldo	Concentrates	3	.77	62.1
		Tailings	28	.05	4
P 194 C through ½.	Do	Concentrates	9.5	.19	51.4
		Tailings	129.5		

Lots in which a high per cent of gold and platinum was saved, but the concentrates are too large in quantity, or there is some imperfection in the assays not yet located, or both.—Con.

Record number.	Locality from which sample was obtained.	Material.	Quantity.	Actual value of gold and platinum in product.	Percentage of value saved.
	OREGON—continued.		*Pounds.*		
P 102 C	Coos County, Randolph district, beach.	Concentrates 1 and 2	165	$0.075	18.03
		Tailings	402	.026	6.3
	Curry County:				
P 87 B	Port Orford	Concentrates 1	18	.018	60.75
		Tailings and concentrates 2.	312		
P 88	Port Orford beach	Concentrates 1 and 2	37	.033	40.61
		Tailings	121.25		
	WASHINGTON.				
	Pacific County:				
P 534	Beards Hollows	Concentrates 1 and 2	114.5	.05	83.3
		Tailings	90	.01	16.7
P 535	Fort Canby	Concentrates 1 and 2	3,663	1.96	68
		Tailings	3,462		
	WYOMING.				
P 432 A	Sand Creek and Spotted Tail Creek.	Concentrates 1 and 2	49	.42	93
		Tailings	17	.02	7
P 432 B	Do	Concentrates 1 and 2	37	.23	95
		Tailings	8	.01	5

Lots in which the concentrates show values, while the original samples failed by assay to show any. The percentage can not therefore be computed.

Record number.	Locality from which sample was obtained.	Material.	Quantity.	Actual value of gold and platinum in product.
	ALASKA.		*Pounds.*	
P 65	Cape Nome	Concentrates 1	147.25	$0.047
		Tailings and concentrates 2	1,941.75	Trace.
	CALIFORNIA.			
P 625	Butte County, Oroville	Concentrates	7	.008
		Tailings	19,652	
	Humboldt County:			
P 89 B	Gold Bluff	Concentrates 1	24.5	.038
		Tailings, including concentrates 2.	167	
P 130 A	Between Orick and Trinidad.	Concentrates 1	17.5	.01
		Tailings and concentrates 2	246.5	
P 610	San Francisco	Concentrates 1	103	.18
		Tailings and concentrates 2	13,351	
	IDAHO.			
P 113	Ada County, Boise	Concentrates 1	.25	.004
		Tailings, including concentrates 2.	57.75	
	MONTANA.			
	Custer County:			
P 489 A	Miles City	Concentrates	5.5	.01
		Tailings	246.5	
P 489 B	Do	Concentrates 1 and 2	8.25	.13
		Tailings	615.25	
P 489 C	Do	Concentrates 1 and 2	32.5	.04
		Tailings	993.5	

Lots in which the concentrates show values, while the original samples failed by assay to show any. The percentage can not therefore be computed—Continued.

Record number.	Locality from which sample was obtained.	Material.	Quantity.	Actual value of gold and platinum in product.
	OREGON.		*Pounds.*	
P 488	Clatsop County: Near Seaside	Concentrates 1 and 2	26.75	$0.02
		Tailings	859.25	.....
P 700	Warrenton	Concentrates 1	6.2	.01
		Tailings and concentrates 2	933.2	.....
P 102 D	Coos County, Randolph district, beach.	Concentrates 1	4.5	.013
		Tailings, including concentrates 2.	123.5	.....
P 97	Curry County, Rogue River, beach.	Concentrates 1	21	.003
		Tailings, including concentrates 2.	44.5	.....
P 818	Multnomah County, Portland, Glisan street.	Concentrates 1 and 2	5.2	.....
		Tailings	680.2	.005
P 70	Polk County, Falls City	Concentrates 1	9.5	.036
		Tailings	124.5	Trace.
	WASHINGTON.			
P 134 B	Chehalis County, Joe Creek	Concentrates 1	5.5	.005
		Tailings and concentrates 2	112.5	.....
P 530	Pacific County, Oysterville	Concentrates	7	.02
		Tailings	373	.....
	WYOMING.			
P 663 B	Albany County, Sherman	Concentrates 1 and 2	15	.004
		Tailings	17	.....
P 662 A	Sweetwater County: Green River	Concentrates 1 and 2	32	.46
		Tailings	259	.....
P 662 C	Do	Concentrates 1 and 2	9	.003
		Tailings	90.5	.....

Lots in which the reduction of values in the tailings is complete, but the weight of the concentrates is much too large.

Record number.	Locality from which sample was obtained.	Material.	Quantity.	Actual value of gold and platinum in product.	Percentage of value saved.
	ALASKA.		*Pounds.*		
P 490 through 2 on ½.	Alaska (through Seattle)	Concentrates 1 and 2	45	$0.88	40.9
		Tailings	39.5	.....	.....
	CALIFORNIA.				
P 99	Del Norte County, Crescent City.	Concentrates 1, 2, and 3	837	.12	78.49
		Tailings	459	.....	.....
P 89 A	Humboldt County, Gold Bluff.	Concentrates 1	41.5	.647	99.17
		Tailings	175.5	.....	.....
	IDAHO.				
P 433	Idaho County, Elk City district.	Concentrates 1 and 2	24	.03	100
		Tailings	7	.....	.....
P 283 through 2 on ½.	Nez Perce County, Dent.	Concentrates 1 and 2	28.5	.39	100
		Tailings	2.5	.....	.....

Lots in which the reduction of values in the tailings is complete, but the weight of the concentrates is much too large—Continued.

Record number.	Locality from which sample was obtained.	Material.	Quantity.	Actual value of gold and platinum in product.	Percentage of value saved.
	OREGON.		*Pounds.*		
	Coos County:				
P 375 A through 8 .	Bullards	Concentrates 1 and 2	1,664	$0.78	82.1
		Tailings	987		
P 102 F	Randolph district, beach.	Concentrates 1, 2, and 3	385	.14	98.27
		Tailings	171		
	Curry County:				
P 46	Gold Beach	Concentrates 1 and 2	49	.041	99.81
		Tailings	58.25	.001	2.56
P 86	Chetco	Concentrates 1 and 2	429.2	.05	73.09
		Tailings	36.8	.0004	.6
P 67 B	Josephine County	Concentrates 1 and 2	157.5	.153	100.8
		Tailings	565.5		
P 194 B through 2 on ½.	Waldo	Concentrates 1 and 2	18	4.12	88.2
		Tailings	25		
	SOUTH DAKOTA.				
P 282	Lawrence County, Bear Creek, near Tinton.	Concentrates 1 and 2	52	.69	98.5
		Tailings	21		

Lots in which the values are so minute that concentration has failed to reduce the values in the tailings and the assays fail to check up.

Record number.	Locality from which sample was obtained.	Material.	Quantity.	Actual value of gold and platinum in product.	Percentage of value saved.
	CALIFORNIA.		*Pounds.*		
P 89 C	Humboldt County, Gold Bluff.	Concentrates 1 and 2	96.5	$0.061	9.5
		Tailings	986	.291	45.25
	IDAHO.				
P 105	Ada County, Boise	Concentrates 1 and 2	7	.017	15
		Tailings	289	.080	69.8
P 81 B	Bingham County, Quaker River.	Concentrates 1 and 2	3	.001	35.16
		Tailings	12	.002	75.25
P 249 through ½	Boise County, Centerville	Concentrates 1 and 2	3.25		
		Tailings	147.75	.08	88.8
P 337 A	Elmore County, junction of Boise and Feather rivers.	Concentrates	4	.003	30
		Tailings	28	.008	80
P 182	Lincoln County, Shoshone.	Concentrates	.4		
		Tailings	28.6	.001	25
	Shoshone County:				
P 290 through 2 on ½.	Pierce	Concentrates 1 and 2	16	.005	71.4
		Tailings	44	.004	57.1
P 293 through 2 on ½	do	Concentrates 1 and 2	16.5	.003	30
		Tailings	298.5	.002	20
	MARYLAND.				
P 298	Ocean City beach	Concentrates 1 and 2	8.5	.002	25
		Tailings	74	.003	37.5

Lots in which the values are so minute that concentration has failed to reduce the values in the tailings and the essays fail to check up—Continued.

Record number.	Locality from which sample was obtained.	Material.	Quantity.	Actual value of gold and platinum in product.	Percentage of value saved.
	OREGON.		*Pounds.*		
P 26	Clatsop County, Gearhart beach.	Concentrates 1 and 2	5.5	$0.004	17.08
		Tailings	96.5	.018	83.32
	Coos County:				
P 727	Coos Bay	Concentrates 1 and 2	22	.04	47.1
		Tailings	53	.014	16.5
P 101	Whiskey Run	Concentrates 1 and 2	1.93	.0008	39.07
		Tailings	23.07	.0013	60.77
	Curry County:				
P 87 A	Port Orford	Concentrates 1 and 2	82	.026	31.46
		Tailings	476	.047	56.30
P 135	Ophir	Concentrates 1 and 2	2.5	.001	6.2
		Tailings	40	.007	46.2
P 166		Concentrates	8.5		
		Tailings	393.5	.03	100
	WYOMING.				
P 110 B	Bald Mountain district	Concentrates 1 and 2	12.5		
		Tailings	37.5	.004	66.66

Lots in which the precious metals are not in condition for mechanical separation, apparently due to inclusion in grains of other minerals.

Record number.	Locality from which sample was obtained.	Material.	Quantity.	Actual value of gold and platinum in product.	Percentage of value saved.
	IDAHO.		*Pounds.*		
P 281 C	Bannock County, Pocatello.	Concentrates	8	$0.01	
		Tailings	18		
P 626 A	Nez Perce County, Lewiston.	Concentrates 1 and 2	36	.09	33.3
		Tailings	293	.18	66.6
	WASHINGTON.				
P 132	Chehalis County, Cow Point, Hoquiam.	Concentrates 1 and 2	62.5	.008	16
		Tailings	1,332.5	.046	84
P 697	Whatcom County, Excelsior.	Concentrates 1 and 2	40.2	.13	29.5
		Tailings	1,389.8	.10	22.7

COSTS OF CONCENTRATION.

With the varied conditions to be met in black sand mining, little can be contributed of general interest to the profession in regard to the cost of handling placer gravels and sands. The following items, however, determined at the Portland plant, may be of interest:

The horsepower of the machines used in the pavilion was measured electrically, and the following results obtained:

Electrical measurement of horsepower in machines used.

Machine.	Volt.	Amperes.	Horse-power.
Wetherill	500	1.25	0.835
Wilfley	480	1.25	.81
Feeder, elevator, screen, and distributor	485	3.00	1.925
Sample grinder	505	5.25	3.554
Crushers and grinders	505	8.00	5.44
Woodbury	505	.8	.544
Christonsen	520	1.25	.87
Pinder	510	1.5	1.15

As to the actual cost of operating shaking tables, the following remarks are of interest Mr. J. Andrew Wauchope gives his results of the extended use of the Pinder table. Capt. J. W. Pinder, inventor of the Pinder table, also furnishes his estimate. Similarly, in regard to the Wilfley table, two estimates are given, the first by Mr. Arthur Goodall, an experienced user of such machines, and the second by Mr. A. W. Park, who was in 1905 the representative of the Mine and Smelter Supply Company, operating the Wilfley table at the Portland Exposition.

Estimates of cost of concentration of black sands under different conditions.

	Per ton.
J. Andrew Wauchope, estimates on Pinder table	$0.042
J. W. Pinder, estimates on Pinder table	.074
Arthur Goodall, estimates on Woodbury or Wilfley	.066
A. W. Park, estimates on Wilfley (omitting cost of water)	.039

The Mine and Smelter Supply Company has furnished the following estimate for a small plant for treating black sands, the first estimate being for ordinary gravel too coarse for use with the sand pump, the second where the sand pump is substituted for an automatic feeder:

Estimate of cost of plant for treating black sands.

1 standard type challenge ore feeder, complete	$80.00
1 6-inch bucket elevator, 20-foot centers, complete, with all necessary head irons, foot irons, and cast-iron elevator boot, necessary best grade of rubber belt, pressed-steel buckets and bolts	111.75
1 revolving Trommel screen, 24-inch diameter by 6 feet long, complete, with sheet-iron housing as shown on page 39 of No. 13 Bulletin, screen covered with 10-mesh, No. 18 steel wire screen	117.00
1 revolving Trommel as above, except covered with 30-mesh, No. 28 steel wire screen	100.00
1 No. 5 latest improved Wilfley table, complete, with middling elevator	450.00
1 9-horsepower Stickney gasoline engine, complete, ready to run	375.00

For plant using 2-inch centrifugal sand pump in place of feeder and elevator, deduct price of feeder and elevator, or $191.75, and add the price of—

1 2-inch Card and Weber centrifugal sand pump, with chilled-iron side plates and runner, as per our Bulletin No. 9	$90.00
20 feet of 2-inch pipe with elbow and 12-inch long nipple for delivering material into screen	3.00
Shafting, pulleys, boxes, collars, and belting, in either of the above estimates, approximately	70.00

ELECTRIC SMELTING OF MAGNETITE FROM BLACK SANDS.

By David T. Day, C. E. Wilson, and G. Howell Clevenger.

FIRST SERIES OF EXPERIMENTS.

The investigation of the useful minerals contained in the black sands of the Pacific Slope has made it evident that very considerable supplies of magnetic iron ore can be obtained by magnetic concentration at low cost at various points on the Pacific Ocean beach and occasionally also at the mouths of rivers in still water. It became important to determine the readiness with which this fine sand could be smelted into pig iron and steel and to determine to what extent the titanium usually found in the magnetite might affect the smelting unfavorably or favorably.

Blast furnace coke of good quality is not usually made on the Pacific Coast. On the other hand, electric power may be obtained at a low rate of cost from the water powers of the Pacific slope. The cost is fully as low as the rates prevailing at Niagara Falls. The usefulness of the magnetic iron ore from the beach sands depends largely, therefore, upon electric smelting. Mr. C. E. Wilson, one of the electric smelting experts of the Wilson Aluminum Company, of West Virginia, was selected for carrying out these experiments.

This work was not taken up until October 11, 1905, near the close of the Portland Exposition, at Portland, Oreg.

FURNACE A.

Mr. Wilson constructed a furnace of the following design: Upon a course of ordinary Carnegie fire brick a cast-iron plate was laid, five-eighths inch thick by 3 feet square. Upon this was placed an oval boiler-iron drum of No. 16 iron and 3 feet high. The sides of this drum were lined with fire brick, so arranged as to form a crucible 18 by 18 inches and 24 inches high. The bottom of the crucible was covered from the cast-iron plate to the tap hole with broken carbon electrodes. An ordinary carbon electrode was mounted in a water jacket holder and suspended by a pulley over the furnace and connected with a balanced axle and wheel, so that it could be raised and lowered. The top of the furnace was covered with double plates of riveted wrought iron. In the center of this water jacketed cover an opening was left sufficient to allow the free play up and down of the carbon electrodes.

POWER FOR FURNACE A.

Through the cooperation of the Portland General Electric Company, a special wire, bearing a 2,300-volt alternating current, was run from the city supply to the smelter. This was carried into a series of 6 transformers and yielded a current varying from 50 to 70 volts by 1,000 to 2,000 amperes.

INITIAL RUN OF FURNACE A.

On the afternoon of October 17 a current of 57 volts and 1,000 amperes was passed through the furnace and the arc established. The furnace was then fed with a mixture of magnetite, coke, and lime. This consisted of 200 pounds of magnetite, obtained from the sand at Hammond Station, near Astoria, Oreg., at the mouth of Columbia River; 44 pounds of "Fairfax" coke, which contained about 25 per cent of ash, and 24 pounds of lime. About 150 pounds of this charge was slowly introduced into the furnace, and within an hour there was tapped from the furnace 70 pounds of iron and slag, which contained 8 per cent of iron and 53 per cent of titanic acid.

On the following day the furnace was again heated and filled with a mixture similar to that used on the first run, except that it contained less lime. Steel was successfully cast twice, making for that day's run of two hours a product of 90 pounds of steel from 300 pounds of iron ore. This gives the furnace a capacity on a continuous run of 1,440 pounds in twenty-four hours.

COMPOSITION OF CHARGE.

The iron ore fed to the furnace showed the following percentages of magnetic oxide, of titanic acid, manganese, and undetermined matter:

Analysis of Columbia River sand concentrates.

Fe_3O_4	79.06
TiO_2	16.00
MnO_2	2.45
Silica, moisture, and undetermined matter	2.49

It will be noted that the heat was sufficient to keep the entire slag in a fluid state, whether much or little titanic acid was present. It is evident also that no titanium went into the iron.

NATURE OF SLAGS OBTAINED FROM FURNACE A.

The slags first obtained consisted of fused iron silicates, fused oxide of iron, and silicate of titanium. Later in the experiments these slags grew lighter in color and in specific gravity. It became possible also to lessen the quantity of slag produced, which was unduly large owing to the great quantity of ash in the coal. The coke used showed on analysis 41 per cent of ash. It was difficult to procure in this locality coke that is well adapted to metallurgical needs.

The record of the daily runs of Furnace A is as follows:

Record of daily runs of Furnace A.

Number of run.	Date.	Hours run.	Volts.	Amperes.	Mixture used.				Total weight of mixture.	Metal tapped from furnace.	Slag produced.	Carbon electrode consumed.	Horsepower.	Metal produced per horsepower day.	Magnetic iron ore per pound of steel.
					Magnetite.	Coke.	Limestone.	Sand.							
	1905.				*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*
1	October 17....	1½	57	1,000	200	44	24	.....	268	70	.....	1.80	76.40	14.66	2.86
2	October 18....	2	57	1,000	300	60	30	.....	390	90	200	2.10	76.40	14.14	3.33
3	October 20....	2	57	1,800	97	19	8	.....	124	23	125	1.20	137.53	2.01	4.22
4	October 20....	2	57	2,000	91	21	4	.....	116	120	88	3.50	152.81	9.42	[a].76
5	October 21....	2	57	1,800	150	74	7	.....	231	23	115	2.30	137.53	2.01	6.52
6	October 21....	2	57	1,800	102	27	2	.....	131	106	105	3.20	137.53	9.25	1.03
7	October 23....	8	57	1,200	500	100	24	10	634	247	410	2.80	91.68	8.08	2.03
8	October 25....	3	57	1,200	202	40	12	12	266	38	150	3.50	91.68	3.31	5.32
9	October 26....	1	115	800	298	60	30	10	398	122	120	4.00	123.32	23.75	2.44
10	October 27....	5	115	1,200	800	160	96	.....	1,056	263	318	2.00	184.98	6.83	3.04
11	October 30....	3	115	1,200	800	154	64	.....	1,018	200	400	1.50	184.98	8.65	4.00
12	October 31....	5	115	1,200	1,200	175	112	.....	1,487	575	280	3.00	184.98	14.92	2.09

[a] Part of metal comes from previous charge

FURNACE B.

It was thought desirable to build a larger furnace with thicker walls in which higher temperatures might be obtained and maintained. An iron plate 2 inches thick, 5 feet wide, and 6 feet long was therefore procured and laid upon two courses of fire brick to form the base of a furnace, on which was set a wrought-iron cylindrical shell one-quarter of an inch thick, 5 feet in diameter, and 4 feet high. This was lined with fire brick, the bottom having the usual lining of one course of carbon electrode bricks

4 inches in diameter. Two carbons clamped together with a water-jacketed head or clamp formed the electrode for introducing the current. The voltage was run up as high as possible—that is, from 75 to 90 volts, the limit of the current obtainable over the wires. In all respects except these mentioned this second furnace was identical with the first.

Iron ore from Aptos, Bay of Monterey, California, was smelted in this furnace on November 10. This iron ore is very fine grained and contains a notable percentage of manganese, much of which goes into the iron. It is not so rich in titanium as the other sands that had been used. From the start this furnace made a satisfactory run, maintaining easily a high temperature and turning out a very smooth product. After a few trials the slag became as light in color as that from any well-regulated blast furnace. In every case, however, small blowholes were observable in the metal. These were due to gases which formed wherever grains of magnetite were still entangled in the metal in process of reduction. The capacity of this furnace with a current of 125 volts, 1,200 amperes, would be 2,000 pounds in twenty-four hours.

The record of the daily runs of furnace B is as follows:

Record of daily runs of furnace B.

Number of run.	Date.	Hours run.	Volts.	Amperes.	Mixture used. Magnetite.	Coke.	Limestone.	Total weight of mixture.	Metal tapped from furnace.	Slag produced.	Carbon electrode consumed.	Horsepower.	Metal produced per horsepower day.	Magnetic iron ore per pound of steel.
	1905.				*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*
1	November 10...	4	100	1,200	1,000	200	160	1,360	480	250	2.00	160.86	17.91	2.08
2	November 11...	7	75	1,600	1,000	250	48	1,298	175	312	3.69	160.85	3.69	[a]5.71
3	November 14...	9	80	2,000	858	154	18	1,030	450	457	6.00	214.47	5.59	1.91
4	November 16..	8	80	2,000	800	170	84	1,054	[a]1,025	500	8.00	214.47	14.34	[b].78

[a] Metal not all tapped. [b] Includes metal not tapped from previous run.

As a result of the above general method of operation, a considerable quantity of metal was produced. The product varied greatly and, apparently, there was absolutely no control over the work of the furnace. Runs upon the same raw material would in some cases show low phosphorus and other runs would show high phosphorus. The same was true of the sulphur and the carbon, the carbon ranging from that contained in medium steel to that contained in white iron. In some cases, chemically, the product appeared to be good. Invariably the product was poor physically, being full of blowholes.

DISCUSSION OF RESULTS OF FIRST EXPERIMENTS.

By G. Howell Clevenger.

A process to produce steel direct from the ore would have to provide for the following requirements:

1. Reduction of the metal from the ore.
2. Oxidation of surplus carbon and impurities.
3. Deoxidation and killing.

A consideration of the preceding text shows that it is impossible to fulfill these requirements at one operation, as the conditions necessary for each stage are directly opposed to one another.

All the slags made in these first operations were very ferruginous and consequently highly oxidizing. This is the case even with considerable excess of reducing agent and with sufficient lime to satisfy the acid constituents of the charge. This is due to the fact that the ore at once comes into the smelting zone and becomes melted before the iron is thoroughly reduced.

Thus it will be seen that by this method requirements one and two are but imperfectly carried out and absolutely no provision is made for requirement three.

Reduction is very imperfect, as is indicated by the high iron content of the slags. Oxidation is irregular and uncertain, as is indicated by the erratic elimination of sulphur and phosphorus and the great variation of the carbon content when smelting the same charges and under the same conditions.

As is well known, a very strong reducing action and a high temperature are necessary for the elimination of sulphur. Phosphorus may be eliminated by a ferruginous slag under proper conditions, but at a high temperature metallic iron reduces phosphorus from this type of slag. Thus the phosphorus passes back into the steel, even if once removed.

In many cases the high carbon content of the metal was caused by absorption of carbon from the lining of the furnace. This theory is supported by the furnace tapping itself upon one occasion just as one of the charges was completely melted down. This metal was low in carbon, while charges run upon the same material, which were allowed to remain in the furnace for a time after fusion, were high in carbon.

Deoxidation and killing is not provided for at all, the metal being tapped while in contact with the highly-oxidizing ferruginous slag. This accounts for the large number of blowholes and the general unsoundness of the metal.

Summing up this method of working, it is imperfect as regards reduction of the iron and oxidation of the impurities, and further deoxidation and killing of the metal are not provided for at all.

And yet, notwithstanding the apparent very great weakness of this method, it is possible that, so far as electric smelting is concerned, it may prove the best practice where steel is the final product desired. Thus, during the reduction, by sacrificing a portion of the iron, much of the carbon and other impurities can be kept out of the metal, and the further refining of the metal can be much more quickly accomplished than where the iron is completely reduced from the ore, in which case it contains the maximum amount of carbon and other impurities. The deciding point between these two methods of working would be whether it was more advantageous to allow a portion of the iron to go to waste or to expend more energy in refining the final product. Of course, in this connection, the total amount of energy used in either case must be considered; that is, reduction plus refining in each case.

Dr. G. Howell Clevenger, formerly associate professor of metallurgy in Stanford University, was engaged in August, 1906, to extend the first series of experiments. His report follows.

SECOND SERIES OF EXPERIMENTS.

By G. Howell Clevenger.

In consequence of the experience gained from the first series of experiments, the following equipment was installed for further experiments: The general plan of operation was that the first smelting operation should be carried on in a furnace of the type used for the first experiments. In this furnace the metal would be reduced and part of the impurities removed, the molten metal being tapped into a second furnace without carbon in the lining, the current entering by one movable electrode and passing out through another. In this furnace oxidation could be finished and deoxidation and killing could be carried on to any degree desired.

FURNACE C.

The furnace equipment consisted of one furnace of the type previously described, having the following dimensions: Bottom plate, 60 by 72 by 3 inches; shell, 60 inches in diameter and 60 inches in height; carbon crucible, 20 by 20 by 31 inches; thickness of sides of crucible, 4 inches; of bottom, 28 inches; size of movable electrode, 10.5 by 10.5 by 38 inches.

FURNACE D.

The other furnace was of the Heroult type, designed to use two 4-inch electrodes. The lining was finely-crushed chromite, held together by fire clay. This furnace was placed so that the metal could be tapped into it from the reduction furnace.

POWER FOR FURNACES.

The current came to the plant at 2,300 volts and was reduced to 110 volts by nine 30-kilowatt and six 15-kilowatt transformers. These transformers were of the ordinary oil-cooled, lighting type, such as is used in the city of Portland by the Portland General Electric Company.

The secondary current was carried to a rough switch board, where were located an ammeter and a volt meter. From this switch board the current was carried to the furnaces.

This was the equipment as it stood when I was asked by Doctor Day to take charge of the furnace work.

RUNS OF FURNACE C.

The first run was made in the reduction furnace upon magnetite separated by a Ding's magnetic separator, from beach sand from the mouth of the Columbia River. The charge was made up as follows:

Composition of charge of run No. 1 of furnace C.

	Pounds.
Columbia river magnetite	400
Lime (to pass ½-inch ring)	50
Charcoal (to pass 2-inch ring)	100

Analysis of the separated magnetite.

Silica	4.32
Ferric oxide	82.30
Phosphorus pentoxide	0.43
Titanium oxide	9.10
Calcium oxide	0.88
Magnesium oxide	0.71
Sulphur	0.08
Loss and not determined	2.18
Total	100.00

Analysis of lime used in charge.

Silica	0.53
Calcium oxide	79.45
Magnesium oxide	12.90
Sulphur	Trace.
Phosphorus pentoxide	.28
Carbon dioxide and not determined	6.84
Total	100.00

Analysis of charcoal used in charge.

Volatile matter	33.26
Fixed carbon	65.71
Ash	1.03
Total	100.00

Run No. 1.—This roughly mixed charge was slowly fed into the furnace after allowing the furnace to warm up for about half an hour. The duration of this run was but two hours and was in the nature of a trying out of the furnace and other appliances. The result of this run was to show a general weakness of the equipment and thoroughly demonstrated that carbon as a lining for the sides of a furnace of this type is not satisfactory.

When the furnace is cold, as in starting up, there is no difficulty if the electrode is kept centered; but as the furnace becomes hotter and becomes filled to a greater or less extent with metallic vapors, the arc will leap a longer distance, and the result is that the arc occurs at intervals between the sides of the furnace and the electrode.

But a small portion of the charge was put through. All the iron obtained was white. No record of weight of iron was kept, as the run was of such short duration that the results would be of no value. Due to the severe arcing at the sides of the furnace the carbon sides as well as the electrode were badly damaged. The mean volts were 117 and the mean amperes 2,633.

Alterations for run No. 2.—After replacing the carbon sides of the crucible by silica brick and adding extra cable for the carrying of the current to the furnace, the second run was undertaken. The same furnace section was maintained as with the carbon lining; that is, 20 by 20 by 31 inches.

Run No. 2.—The charge for this run was made up as follows:

Charge for run No. 2 in furnace C.

	Pounds.
Magnetite from black sand (fines)	500
Charcoal	125
Lime	40

Great difficulty was experienced in mixing the charge, as the fine, heavy magnetite would sift down through the remainder of the charge.

Feeding of the charge was started soon after turning on the current, and as soon as the furnace got hot enough to hold the arc the furnace was filled right up to the top.

As the furnace got hotter the conductivity of the charge became greater, and as the current could not be increased above about 3,000 to 4,000 amperes and the voltage could not be regulated, the result was that the electrode had to be constantly raised.

Notwithstanding the silica brick sides the arc was very soon on top of the charge, which was, of course, at the top of the furnace. With the inflexible current it was necessary to return to the method of smelting pursued in the first experiment—that is, to maintain an arc between the surface of the bath and the electrode, to feed in the charge a very little at a time, and thus to have absolutely no column of charge. This method was continued until a fuse blew out at the power station, and work was stopped for the day.

During this time two charges, less 260 pounds, were smelted in the furnace, 1,070 pounds in all. From this were obtained 152 pounds of iron, mostly gray, and 289 pounds of slag. It is evident that most of the iron went into the bottom of the furnace.

The total time of the experiment was two hours and fifteen minutes.

The total power used was—

Mean amperes	3,420.0
Mean volts	104.1
Apparent kilowatt hours	801.0

At this time there was no watt meter in circuit, and as the power factor of the furnace is not known the true watts can not be given. The power factor of the furnace was likely about 0.7, and apparent kilowatt hours multiplied by 0.7 will give, approximately, true kilowatt hours. The analysis of the iron from this run follows:

Analysis of iron from run No. 2 of furnace C.

Carbon	(*a*)
Silicon	1.81
Manganese	.07
Phosphorus	.386
Sulphur	.012

This iron was a close-grained gray iron of remarkable toughness.

The electrode for this run was ordinary carbon 10.5 by 10.5 by 36 inches. The weight before using was 416.5 pounds; after using, 365.5 pounds; consumption of electrode, 51 pounds. It lost in length about 2 or 3 inches, but had become pointed. This would account for the apparently large loss in weight for the quantity of iron produced.

It is the tendency of these electrodes to become pointed; hence they should be molded pointed in order to avoid to a certain extent this extra loss on a new electrode.

The starting and the stopping of the furnace, especially the stopping, are by far the hardest items of the run upon the electrode. I consider the results of electrode consumption obtained from short runs to be misleading and invariably high.

As a result of the experience with the electrode of the first run, which was badly cracked and shattered when first heated up, all electrodes used in subsequent experiments were annealed before using—that is, they were heated until all moisture had been driven out of them.

The electrode used in the second run was thus treated and showed only a small amount of cracking, which did no damage. At an early stage of the smelting the portion of the electrode exposed to the air became coated with slag and fine particles of charge thrown up from the furnace by the boiling. This protected the electrode from the action of the air, and as a result the whole electrode, except at the point, remained intact.

The silica lining of the furnace was in places almost entirely eaten away. This was caused by the basic nature of the slag, due to the large quantity of iron it contained. This is due to the method of smelting with a shallow bath and no column of charge. The magnetite under this condition of operating is not completely reduced to metallic iron before it reaches the smelting zone, and hence it attacks the silica lining. The slags obtained by this method of working are invariably high in iron and very heavy. A serious difficulty encountered was the very violent boiling of the charge, at times so severe that it ran over the top of the furnace. This was probably caused by the fineness of the magnetite, which upon striking the incandescent bath would become partly reduced very quickly, thus giving off much gas below the surface of slag. This probably can be largely remedied by briquetting the fine magnetite.

Alterations for run No. 3.—Based upon the experience of the 2 former runs, still further alterations were made, as follows: Connecting transformers were installed, so that the following voltages could be obtained at will—27 volts, 37 volts, 55 volts, 110 volts. The furnace was lined with an acid lining made from crushed quartz, with 10 per cent of fire clay to bind it. This lining was round instead of square in section, as in the case of former linings; top and bottom, 16 inches in diameter; middle, 18 inches in diameter; depth, 31 inches. Round 8-inch graphite electrodes were used instead of the square carbons, which were used in former runs. The graphite electrodes came in lengths of 49 inches. One and one-half of these lengths were connected together by the usual method of cutting threads and screwing together. This made an electrode 8 inches in diameter by 5 feet 6 inches long. A new electrode holder was designed and constructed so that it would accommodate either the round graphite electrodes or the square carbon electrodes. This holder was water jacketed and built of such proportions that no difficulty was experienced from heating at the junction of the electrode and the holder, as in the previous work. Ten flexible 0000 cables

(*a*) Not furnished.

were moused to 6-foot lengths of 0000 solid copper wires. These were fastened in the holder by means of set screws. This arrangement proved very satisfacotry, no heating of the electrode holder or connections occurring throughout the run. Connection to the bottom of the furnace was made by means of ten 0000 flexible copper cables moused to 12-inch lengths of 0000 copper wire. These were fastened to heavy brass lugs by means of set screws. These lugs were securely bolted to the bottom plate of the furnace. Up to this time no watt meter was in circuit, due to the inability to obtain an instrument. Through the efforts of the Portland General Electric Company this valuable adjunct was obtained. It was, however, found necessary with the type of instrument used to place it upon the primary side of the circuit. To obtain watts actually consumed at the furnace, it will be necessary to multiply indicated watts by the power factor of the transformers, which in this case is about 0.90.

Run No. 3. After making these alterations the third run was started, using Wyoming magnetite, the analysis of which is given as follows:

Analysis of Wyoming magnetite used in run No. 3 of furnace C.

Silica	1.64
Ferric oxide	83.43
Titanium oxide	14.06
Calcium oxide	.22
Magnesium oxide	1.14
Sulphur	.03
Total	100.52

The silica used in the charge was pure quartz, running over 99 per cent silica.

The charge was made as follows:

Charge of run No. 3 of furnace C.

	Pounds.
Magnetite (pass ¾-inch ring)	500
Charcoal	100
Limestone	15
Silica	5

The current was turned on and after running for about five minutes the charge was filled up to the top of the furnace. Everything ran smoothly for several hours, then trouble commenced to be experienced by the charge partially fusing and hanging at the top of the furnace. At first this trouble could be remedied to a certain extent by working down the charge by means of raising and lowering the electrode. Later stoking down with iron bars had to be resorted to.

After the furnace had been running for some time much trouble was experienced by violent boiling of the charge. This caused a great loss of efficiency in the furnace. This was probably caused by the small section of the furnace at the slag level and the fineness of the charge.

During this run 6 charges of Wyoming ore were run and 4 charges of black sand briquets of 500 pounds each. The briquets were made up as follows:

Composition of iron ore briquets in run No. 3 in furnace C.

	Pounds.
Magnetite (fines)	500
Charcoal	100
Lime	40
Fire clay	50

The total time of the run was thirty-six hours.

The total iron in the charge was:

	Pounds.
Iron in Wyoming magnetite	1,753
Iron in black sand briquets	821
Total	2,583

The total iron produced was:

	Pounds.
Total iron in charge	2,583
Total quantity of iron weighed up	2,246
Iron lost in slag	337

True kilo watt hours as indicated by watt meter for total run, 4,720; 4,720 by 0.90 (approximate power factor of transformers)=4,248 kilo watt hours, amount of current consumed by furnace. Current consumed per ton of 2,000 pounds of pig iron produced, 3,760 kilo watt hours.

Graphite electrode consumed during run amounted to 205 pounds.

DISCUSSION OF RESULTS OF RUN 3.

The iron produced varied from white to gray. The following are analyses of typical specimens of the gray iron:

Analyses of specimens of gray iron from run No. 3 of furnace C.

	Tap No. 1.	Tap No. 2.
	Per cent.	*Per cent.*
Silicon	1.040	0.930
Manganese	Trace.	None.
Phosphorus	.114	.074
Sulphur	.009	.005
Total carbon	4.810	4.300
Titanium	....	.530
Chromium	....	.090

A sample of the slag showed 26.16 per cent titanium.

A number of castings were made from the metal direct from the furnace. These were invariably sound and of excellent quality.

The consumption of electrical energy per ton of pig iron produced, is not so good as indicated by some other recently published figures; but this is due to the high titanium content of the ores smelted, which necessarily requires more power to reduce, to the short duration of the experiment, and to the very irregular working of the furnace a part of the time.

A very noticeable feature was the extraordinary consumption of electrode. There seemed to be very little tendency for the slag to form a protective coating upon the graphite electrodes, as in the case of the carbon electrodes. As a partial explanation of the heavy electrode consumption, I offer the following: Conductors carrying heavy currents are surrounded by strong lines of magnetic force. This was very forcibly shown in this case by the attraction of iron bars and shovels when held near the cables carrying the secondary current, or near the graphite electrode. When the charge is fed into the furnace, the fine particles of magnetite are attracted by the electrode. Thus it is constantly surrounded by this material, which when it becomes heated to a high temperature, becomes a very strong oxidizing agent; hence the rapid destruction of the electrode.

EXPERIMENTS WITH STEEL MAKING.

Furnace No. 2 was changed into the same type as No. 1, except that direct connection was made to the metal bath by means of a water-cooled cast-iron plate and the lining was made of crushed magnesite and tar. The section of the furnace was 24 inches by 24 inches by 36 inches.

This change was made to eliminate the chance of reducing chromium from the lining of the furnace. This would have introduced a new element in uncertain quantities. Further, in the way the lining was set it would not have proved durable, and, further still, greater simplicity could be obtained by having but one movable electrode instead of two. It will be seen that the quantity of carbon in contact with the metal in a furnace of this type is the minimum.

The original idea of tapping the molten metal into the refining furnace had to be abandoned, due to the fact that not enough current was available to run both furnaces at once.

It was planned to run furnace No. 1 and get an accumulation of metal and then to remelt and refine in furnace No. 2. A separate record was to be kept of the amount of current required to melt, and this was to be deducted from the total current consumed, thereby arriving at the same result as by the other method made impossible by our lack of current.

The first plan tried in this furnace was to smelt down black sand briquets until a bath of metal was obtained, then to tap off the slag and proceed with the various stages of refining, the furnace being so arranged that the slag from each operation could be removed.

Four charges of briquets, containing 831 pounds of metallic iron, were smelted with a consumption of 1,920 K. W. H., 1,920 K. W. H. by 0.9=1,728 K. W. H., being the actual energy consumed.

At this point the lining of the furnace gave way, and the experiment had to be stopped.

No weight of iron can be given, as much of it went into the brickwork of the furnace and could not be recovered.

The following are typical analyses of the product:

Analyses of metal obtained in making steel in small furnace.

	Third tap.	Last out of furnace.
Silicon	0.040	0.080
Phosphorus	.075	.459
Sulphur	.058	.233
Combined carbon	1.840	2.800

The sample designated "Third tap" was that produced while the lining was intact, and it demonstrates that with a basic lining and the proper charge metal can be produced which will not require a great deal of subsequent refining.

The sample designated "Last out of furnace" demonstrates the effect of an acidic slag upon the elimination of impurities. This metal was reduced after the magnesite lining had failed, hence the basic slag came in contact with the fire-brick backing of the furnace and rapidly became acidic.

A small furnace of the Heroult type was constructed, an iron oil barrel, with a section cut out of the side, being used for a shell. In this was placed a magnesite lining made from tar and crushed magnesite. This was set upon an iron plate, and could be easily tilted in order to pour off slag or metal. In this furnace was suspended 2 4-inch electrodes, raised and lowered in each case by means of a wire cable and winch, as with the other furnaces.

Run No. 1 (in small furnace).—One hundred pounds of the product from the run upon black-sand briquets in furnace No. 2 was melted and treated with a charge consisting of black sand and lime. Total time of run, 2 hours; current consumed, 120 kilowatt hours.

Partial analysis of product:

Partial analysis of product of run No. 1 in small furnace.

	Per cent.
Total carbon (below)	0.100
Sulphur	.018
Phosphorus	

This metal was malleable and apparently good physically, with the exception that it was slightly cold short. This was due to incomplete deoxidation.

This shows the extent to which impurities can be eliminated by the electric furnace.

Run No. 2 (in small furnace).—Two hundred pounds of the iron produced from Wyoming magnetite in furnace No. 1 was melted down and treated with 20 pounds of mixture of Wyoming ore and lime (50 pounds Wyoming ore and 25 pounds lime). After fusion, the slag was poured off, and 20 pounds more of the mixture was added, fused, and poured off. This was treated once more in the same manner, and just after this charge was fused down the magnesite lining gave way and the experiment came to an end. Samples were taken after the fusion of the iron and after each treatment with ore and lime. The object of this experiment was to give an idea of the rate of elimination of the impurities.

Current consumed in melting charge, 120 kilowatt hours, as indicated by watt meter; current consumed in refining charge, 240 kilowatt hours; total current consumed in this run, 360 kilowatt hours. (To obtain current actually consumed at furnace, multiply these figures by 0.90, the approximate power factor of the transformers.)

Carbon electrode consumed in both experiment, 54 pounds.

The difficulty with the basic linings was caused by using the lightly calcined magnesite, such as is used by paper manufacturers for sizing of their paper stock. After making every effort to obtain magnesite brick this material was turned to as a last resort, and it certainly proved its general unfitness for this purpose.

CONCLUSION.

The second series of experiments were undertaken just as the U. S. Geological Survey was dismantling the plant and leaving Portland. The actual experimental work covered a period of only a week.

Much difficulty was experienced in getting proper refractory material. This very seriously interfered with the work. In addition to this many other makeshifts had to be used. This explains the fragmentary nature of the experiments.

Although many of the results of these experiments are negative, yet it is none the less important to know what difficulties are to be encountered in the further prosecution of this work.

ACKNOWLEDGMENTS.

In addition to those who have already been mentioned as responsible for certain branches of the work, such as the collection of samples for concentration, etc., the following were in responsible charge of individual branches of the organization: Records, Miss A. T. Coons, Miss Maude E. Miner, Miss Mary E. Heggie; sampling and concentration, Hugh Calkins, F. W. Horton, L. G. Gillett, T. W. Johnston; assaying, W. L. Schumacher, J. T. Glidden, F. H. Hazard; mineral identification, W. L. Walker, Roy N. Ferguson, Miss E. L. Stone; computations, Miss Maude E. Miner and Miss Helen Stone; electric smelting, C. E. Wilson and G. H. Clevenger.

The names are given chronologically, and in many cases the same person served in charge of more than one branch at different times.

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CARBON DIOXIDE.[a]

By Myron L. Fuller.

INTRODUCTION OF LIQUID CARBON DIOXIDE.

The quantities of carbon dioxide, or carbonic-acid gas, as it is popularly known, used in the production of carbonated beverages and for numerous other purposes has in recent years reached enormous proportions, and its production has given rise to a business of considerable importance. Up to about twenty years ago all carbon dioxide used was in the gaseous form and was mainly applied in the bottling and soda-water trades, the gas being in many instances manufactured, even by the retailer, by treating limestone or marble dust with acid. The inconvenience of this method, and especially the enactment of city ordinances against introducing the waste from the generators into sewers, led to a demand for a more convenient source, which was met in 1885 by the introduction by a New York firm of liquid carbon dioxide. In spite of its somewhat greater cost it worked its way into favor until there are now about 40 factories producing liquefied carbon dioxide in the United States, the annual output amounting to about 30,000,000 pounds.

SOURCES OF CARBON DIOXIDE.

The calcination process in which magnesium carbonate in the form of the mineral magnesite is finely ground and roasted in iron retorts was formerly among the most common and is still used to some extent. According to Minor the gas, which commences to evolve at a low heat, is allowed to go to waste until all air is expelled from the retorts, after which the heat is increased and the gas conducted to the gasometer. The process requires about 24 hours to complete.

Carbon dioxide is also obtained by treating magnesite, or limestone in the form of marble dust, with sulphuric acid. Still another method is to draw off by suction the carbon dioxide generated by fermentation in closed vats in breweries, the gas being subsequently washed and purified by passing through a solution of potassium permanganate. In Europe the carbon dioxide is most commonly obtained by passing the products of combustion from the burning of coke through potash lye, from which it is later expelled by heating under pressure. A ton of coke will yield on the average about 750 pounds of carbon dioxide. Another relatively recent method is the liquefaction of the natural carbon dioxide obtained from spring waters. This is described in detail on page 7.

[a] For data regarding sources and uses the writer is indebted to Mr. John C. Minor, jr., Chem. Eng., vol. 1, 1905, pp. 212–218; for statistics of production to Mr. D. H. Newland, Bull. 93, New York State Museum, 1905, pp. 942–943; and for geology to memoranda furnished by Messrs. F. B. Weeks and E. C. Eckel.

USES OF CARBON DIOXIDE.

With the introduction of liquid carbon dioxide the applications of the acid were greatly extended, although the use in beverages still remained the most important. A number of the purposes to which, according to Minor, its use has recently been extended are mentioned below in connection with its longer established uses.

Manufacture of carbonated beverages.—The quantity used in bottled beverages and in sodas sold from the fountain is enormous. Twenty pounds of liquid carbon dioxide are required to make 100 gallons of soda water, a quantity not infrequently sold at a single store in a large city on a hot day, and the total quantity so used goes far to make up the thirty million pounds manufactured annually. Much of the remainder is used in bottling. In soda fountains and in filling siphons a pressure of about 180 pounds to the square inch is used, but in bottling 60 pounds is a more common pressure.

Drawing beer.—The use of carbon dioxide to produce the pressure necessary to force beer or similar liquids from the point of storage to the taps is quite general and constantly increasing. The quality of the beer is much superior to that where compressed air is used for the same purpose, there being much less deterioration.

Substitute for secondary fermentation of beer.—The use of carbon dioxide to replace secondary fermentation is rapidly extending because of the great saving of time, although it is claimed by some that the beer so produced is of inferior quality.

Operation of block signals.—Another modern and rapidly increasing use of carbon dioxide is found in the operation of block signals by the electro-pneumatic process. The details are as follows: When a train approaches the signal it short circuits a track battery, thereby opening a relay and closing an electrical contact point, which in turn causes an electro-pneumatic valve to open, provided there is no train on the block ahead. Carbonic acid gas at 54 pounds pressure is thus permitted to pass from a secondary tank, fed by a gas cylinder through a pressure regulator, to the semaphore casting, which, when forced up by the pressure, causes the blade to go from a horizontal or stop position to one of 60°, thus giving a proceed signal to the train.

Extinction of fires.—The use of carbonic acid in the so-called "chemical engines" is very extensive and successful, but in most instances it has been found cheaper to produce the gas in the engine by agitating acid with some mineral carbonate than to use the liquid acid. The quantity of available gas, however, is much less under the present practice than it would be if the liquid form were used. The latter is especially applicable where the fire occurs in a confined space, as in the hold of a vessel, where it has many advantages over water, having not only greater powers of penetration, but also greater efficacy in subduing combustion. It has been estimated that 150 cylinders of carbon dioxide will furnish enough gas to extinguish a fire in every hold of a cotton steamship.

Refrigerants.—Carbon dioxide requires little space as compared with an ammonia-compressing apparatus, and because of less danger from its fumes in case of accidents, the absence of any tainting due to its odor, etc., it has many advantages over other forms of refrigerants on shipboard. It has been extensively used in Europe and elsewhere for this purpose and is coming into use in America, notwithstanding its greater cost. The possibilities of its use as a sterilizing agent and food preservative are also encouraging.

Treatment of logwood.—The use of carbon dioxide in the extraction of dye from logwood tends to form a definite compound and to prevent decomposition, which formerly gave much trouble and detracted greatly from the efficacy of the dye. The coloring agents produced by the new process may be applied much more satisfactorily to cotton fabrics than before, the resulting shades being far more perfect.

Therapeutic uses.—Many thousands of persons, including many who have crossed the ocean from this country, visit and are benefited by the various carbonated baths on the Continent. The internal use is also beneficial in many instances. We undoubtedly have in this country springs of equal medicinal value, which only require proper exploitation to place them with the European springs among the great therapeutic springs of the world.

PRODUCTION OF CARBON DIOXIDE AT SARATOGA SPRINGS.

Although carbon dioxide occurs in almost every natural water, it is rarely present in quantities sufficient for commercial purposes. It is only at Saratoga Springs, New York, that practical use is made of it in the production of the liquefied acid.

Formerly the waters bearing carbon dioxide emerged entirely as natural springs, but as the demand for the waters increased wells were sunk to tap the waters at lower levels. Over 40 such wells, generally 6 inches in diameter and ranging from 30 to 600 feet in depth, have been drilled to secure the carbon dioxide gas, the total yield of which is estimated at about 20,000 pounds per day.

GEOLOGIC CONDITIONS.

The wells at Saratoga are located on a plain of gravel and sand 50 to 100 feet or more in thickness. Below these unconsolidated materials are two limestones of diverse types separated by a fault passing beneath the town and having a bearing a little east of north. North of the town and only a short distance away are outcrops of crystalline rocks such as are characteristic of the Adirondacks. Beneath it and west of the fault is a hard massive bluish limestone known as the Beekmantown, while east of it are the thin bedded arenaceous Trenton limestones.

The wells yielding the waters bottled and sold for medicinal purposes start in drift along the east side of the fault, which they probably encounter at considerable depths and thus obtain their mineral waters. These wells carry much carbon dioxide, but rarely enough for commercial purposes and are seldom utilized as a source of the gas. Most of the gas wells are located south of the town and obtain their gas in part beneath a resistant clay bed which they encounter at 90 feet or less, and in part from the Trenton limestone at depths up to several hundred feet.

SOURCE OF THE CARBON DIOXIDE.

The gas at Saratoga appears to come mainly from the Trenton limestone. None is obtained from the Beekmantown beds west of the fault or from the crystalline rocks; and the numerous wells along the fault, while yielding much gas, do not, as was just indicated, afford it in commercial quantities. At Ballston Spa, a few miles south, carbon dioxide is obtained from the thin shales. The occurrence, though reaching a maximum at Saratoga, is by no means confined to this locality, gas being given off by the springs from the Trenton limestone and the Utica shales over a large area in this portion of the State.

ORIGIN OF THE GAS.

Source in limestones.—The quantity of gas given off, amounting at Saratoga alone to 20,000 pounds daily, is far too great to be derived from the decomposition of carbonaceous organic matter, since the rocks contain little of such materials, and even the small quantity present does not occur in a form capable of affording carbon dioxide.

The giving off of carbon dioxide is characteristic of the closing stages of volcanic eruptions, but the gas is thought to come, perhaps, rather from the country rock with which the heated lavas have come in contact than from the magma itself. In the absence of heated waters or any other indication of recent igneous activity near Saratoga, there is little upon which to base the theory of derivation from such sources. The volume given off, even since the springs have been known, is far too great to have been derived from the stored waters from a magma long since cooled.

The only available sources capable of furnishing carbon dioxide in the quantities observed seem to be the Trenton limestone or the calcareous portions of the Utica shales of the vicinity. The fact that waters carrying an excess of this gas are obtained from these formations over a wide area, but are not found in other rocks, tends to substantiate this view. That the gas at Saratoga is obtained mainly in the vicinity of faults is probably due to the more favorable conditions for underground circulation at such points.

Nature of chemical reaction involved.—Of the substances present in natural waters those which can most readily react with limestone to produce carbon dioxide are the organic acids, colloidal silica, and sulphuric and hydrochloric acids. There is little evidence of the organic acids in the Saratoga waters, the small amount of organic matter present being mainly in the form of free ammonia, with practically no nitrites or nitrates. The magnitude of the operation going on also tends to show the incompetency of such acids. With one exception there is a general absence of sulphates in any but the smallest quantities, so it is probable that sulphuric acid may likewise be ruled out as an agent in the production of the gas. Colloidal silica, especially at high temperatures, might react with the calcium carbonate of the limestone and form the silicate of calcium, thus liberating carbon dioxide. The process is a very slow one at ordinary temperatures, and if actually going on must be adjusted with a nicety almost surpassing belief, since all the waters are unusually low in silica. In the case of chlorine, however, which is present in the waters in great quantity, we have a possible indication of originally muriated waters, such as might be derived from recently injected igneous rocks. The chlorine may very likely have been derived, nevertheless, from the sedimentary rocks. The latter source of the chlorine is inherently much more probable than the former, yet it fails entirely to account for the free acid necessary to react with the limestones. On the other hand, there is no evidence of recent igneous activity which could account for the acid solutions.

There has been recently discovered,[a] however, a volcanic plug a mile north of Schuylerville and about 20 miles northeast of Saratoga, which, from the scoreaceous character of the lava and the imbeded bombs, seems to have been formed when the surface had a level only slightly higher than at present and far below the level of the supposed early Tertiary peneplain in this region. If any weight is to be given to this physiographic evidence, it would appear that the eruption occurred later than early Tertiary and before the close of the later Tertiary period of peneplanation, during which period it is thought the general level from which the plug now projects may have been produced. It is highly improbable that solutions from this period of igneous activity have persisted in the crust to the present time, but the occurrence is suggestive of the possibilities of still later intrusions which may not, however, have reached the surface.

With the little evidence at hand and with the present knowledge of chemical reactions, it seems most likely that the carbon dioxide is being set free from limestones by the action of chlorinated waters, the only source of which, so far as known, seems to be igneous rocks. It is not at all improbable, however, that the gas is given off as the result of some process not yet understood or suspected.

PRODUCTION.

The producers, owing to business rivalry, are not inclined to give information as to the quantity of gas obtained, but it is reported that a considerable proportion of the 20,000 pounds yielded daily is obtained from the drift into which it has passed from

[a] Woodworth, J. B., The Northumberland volcanic plug: Fifty-fifth Ann. Rept. New York State Mus., 1903, pp. r17–r24.

the underlying rocks. Only about half of this is recovered. The largest producers, therefore, are said to be the relatively shallow wells, 30 to 100 feet in depth, of which so many have been drilled south of the town. Of the rock wells, those south of the town yield the most gas, obtaining it at depths said to vary from 150 to 600 feet. The rock gas, if found at all in commercial quantities, is generally encountered at the junction of the argillaceous Utica shale just over the Trenton limestone. Many non-producing wells have been drilled.

The waters from the mineral wells in Saratoga are used mainly for medicinal purposes, although they all carry considerable gas. The following table shows the quantity of free carbon dioxide contained to each cubic foot of water as based on analyses.[a] The waters were bottled at their source, and although there is probably some loss, the quantities are very nearly correct.

Carbon dioxide in mineral waters of Saratoga Springs, N. Y.

[J. R. Haywood and B. H. Smith, analysts.]

Name of spring or water.	Volume of free carbon dioxide to each cubic foot of water.	Name of spring or water.	Volume of free carbon dioxide to each cubic foot of water.
	Cubic feet.		*Cubic feet.*
Vichy	0.255	Seltzer	0.763
Hathorn	.075	High Rock	.172
Arondack	.397	Lincoln	.403
Geyser	.182	Chief	.360
Peerless	.193	Victoria	.161
Magnetic	.034	Carlsbad	.426
Star	.766		

COMPRESSION OF THE GAS.

From the wells, which are usually 6 inches in diameter, the water and associated gas, according to Minor, are piped to a separator, a large tank equipped with a 2-foot trap at the bottom, from which the water escapes, and with a pipe at the top leading to the gasometer into which the gas discharges. But little goes to waste except that actually in solution. From the gasometer the gas is drawn through calcium chloride driers to remove the moisture, after which it passes to the compressor, working generally in three stages, at, approximately, 60, 300, and 1,000 pounds. After a final cooling fixed weights of the gas are admitted into cylinders for shipment.

The cylinders are made of lap-welded or seamless steel tubing; the smaller cylinders are about $5\frac{1}{2}$ inches in outside diameter and 4 feet long and are charged with 20 pounds of gas, while the larger are $8\frac{1}{2}$ inches in diameter and 51 inches long and are charged with 60 pounds of gas. This is two-thirds of the water capacity. The bursting pressure of the tubes varies between 5,100 and 5,900 pounds per square inch in the case of the seamless tubes and between 4,900 and 5,500 pounds for the lap-welded. All are tested to 3,700 pounds before filling. Since the pressure, even at 130° F., is only 2,240 pounds, there is a wide margin of safety.

[a] Mineral waters of the United States: Bull. 91, Bureau of Chemistry, U. S. Dept. of Agr., 1905, pp. 84–97.

GRAPHITE.

By George Otis Smith.

INTRODUCTION.

Graphite is one of the minerals of economic value which attract attention because the domestic demand exceeds the supply. In the better grades of graphite the value of imports is four times that of the graphite mined and refined in this country.

Chemically, the purest graphite is carbon with 0.05 to 0.20 per cent of hydrogen. The commercial grades of crystalline graphite contain clayey impurities, the percentage of ash sometimes reaching as high as 15 per cent even in Ceylon graphite. Certain physical characteristics are possessed by graphite which enable it to be readily recognized. These are its steel-gray to blue-black color, extreme softness, and greasy feel. In the crystalline form graphite is readily cleavable into thin flakes or into thick stems or rods, and in the flake form it possesses a brilliant luster. The distinction between crystalline and amorphous graphite can not be exactly defined. In many cases the graphite termed amorphous differs from crystalline graphite only in the microscopic size of the flakes. On the other hand, the amorphous graphite may be more closely related to anthracite coal than to crystalline graphite, and, in general usage, the term is applied to the metamorphic schists in which the percentage of carbonaceous material is rather high. The differences between true amorphous graphite, amorphous carbon, and amorphous coal are often so slight that only careful chemical tests will serve to decide to which class the material in question really belongs.

The only mineral with which crystalline graphite might be confounded is molybdenite, from which it differs very slightly in color, the streak of molybdenite having a somewhat greenish tinge. Since this mineral is a sulphide and graphite pure carbon the two may be readily distinguished by simple blowpipe tests.

OCCURRENCE.

Graphite commonly occurs as a constituent of the oldest or pre-Cambrian rocks, but its presence is not conclusive evidence of the age of the formation. It is, however, confined to the crystalline schists, in which it is found in three general types of occurrence—in beds, in dikes, and in veins. These represent different types of origin, and as the type may not always be readily distinguished, so also the determination of the genetic relations may be difficult.

Good examples of the bedded deposits of graphite are afforded by the graphite bed near Hague, N. Y., the graphitic shale or schist near Worcester, Mass., the beds of graphitic anthracite in Rhode Island, and a graphitic schist near Madrid, Me. In these cases the graphite deposits appear to represent sedimentary beds rich in carbonaceous matter which by metamorphism has been converted into graphite. Metamorphism, in two of the examples at least, can be attributed to the action of intrusive granitic rock, large masses of which occur in immediate proximity to the graphite locality. In the case of some Alpine deposits of graphite it has been shown that the development of graphite in the metamorphosed carboniferous strata is directly dependent upon the proximity of intrusive granite and independent of the degree of dynamic metamorphism.

Pegmatitic dikes carrying graphite as an original constituent are known in New York, New Jersey, and Maine, and it is probable that the Pennsylvania graphite may belong to this class of deposit. A graphite-bearing pegmatite in Maine, as recently described, contains graphite to the extent of 9 per cent, it being present mostly in evenly distributed flakes with a few nests of pure graphite an inch in diameter. The graphite is disseminated in the larger masses of quartz and throughout the finer grained matrix, although not within the larger crystals of feldspar. It appears, therefore, that the graphite crystallized possibly later than the feldspar, but plainly earlier than the quartz, and that, like both of these minerals, it is an essential and original constituent of magmatic origin.

The third type of occurrence can not always be readily distinguished from that just mentioned. In New York, graphite deposits have been described as having the form of fissure veins, while similar relations and origin have been ascribed to the most important graphite deposits in the world, those of Ceylon. To what extent the vein-filling solutions may have been derived from adjacent granitic masses can not be stated.

Graphite has been reported from all of the Eastern States in which crystalline rocks occur, and in most of these the deposits have been actively prospected at different times. Similar statements may be made concerning the occurrence of graphite in the Western States.

USES.

The characters possessed by graphite and already mentioned make it a mineral of much industrial importance. Its chemical composition makes it a highly refractory material of exceptional value in the steel and other industries; its softness and black streak fit it for the use which has given it the name of graphite, and the perfect cleavage, purity, and softness of this mineral, as it occurs in some localities, make it especially adapted for use as a lubricant. The high electro-conductivity of graphite gives it value for certain electrical supplies.

The largest use that is made of graphite is in the manufacture of crucibles, muffles, and other articles designed to be exposed to high temperatures. For this purpose the Ceylon graphite possesses special advantages in its low percentage of ash and in its peculiar physical characters. It breaks into foliated masses and thick rods rather than into thin flakes, and when crushed the resultant material is more even grained, a condition that apparently favors the production of the right temper in the crucible. Ceylon graphite is imported into this country in large quantities, both by the crucible manufacturers and the steel companies that make their own crucibles. The names applied to the Ceylon product—large lump, ordinary lump, chip, dust, and flying dust—well express the difference in physical structure between this graphite and the flake graphite.

The use of graphite in the manufacture of pencils is probably both its oldest and its best known application. This industry in Germany and England is several centuries old, and many of the modern factories manufacture hundreds of varieties of pencils; yet the percentage of graphite used for this purpose is not large, being undoubtedly less than 10 per cent of the world's production, and one authority even estimates it as low as 4 per cent. Not all graphite is adapted for use in the manufacture of pencils. Here again the physical condition of the material is all important; the flake graphite, however pure, would yield a "lead" that would slip over the paper without leaving more than a faint streak. Furthermore, it is almost impossible to grind the easily cleavable flake graphite into a powder of the fineness and evenness of grain requisite for the better grades of pencils. Therefore, either a high grade of amorphous graphite or very fine crystalline graphite is regarded as furnishing the best material for pencils. Siberia, Bohemia, Ceylon, and Mexico furnish such graphite.

The characteristics which unfit flake graphite for use in pencils make it especially adapted for other purposes, and chief among these is its use as a lubricant. The extreme thinness of the flakes and their flexibility enable them effectually to cover rough metal surfaces and thus to reduce the friction between the bearings. In the case of light bearings, or of machinery where oil can not be used on account of the danger of soiling delicate textiles, graphite can be used alone as a lubricant. In various combinations with light and heavy oils, graphite is being used to a large extent for all kinds of heavy machinery, its nature enabling it to withstand the greatest pressures and highest temperatures. The Ticonderoga flake graphite has a wide reputation as being the best example of lubricant graphite, on account of its natural purity and the perfection of the development of the cleavage.

Flake graphite is also well adapted for use in the manufacture of paint, stove polish, and electrotyper's powder. In paints and stove polish amorphous graphite is also used, and in the manufacture of paint, since silica is believed to give the quality of permanence, all of the siliceous impurities are not separated from the graphite. Flake graphite possesses greater covering qualities and is therefore probably more used as an ingredient in the better grades of graphite paints than is the amorphous variety.

Large quantities of graphite, both crystalline and amorphous, are used for foundry facings. The impure and cheap graphite material mined in Georgia is used to color fertilizers. Another use of crystalline graphite is as a protective polish for gunpowder and as a packing material for the delicate electric-lamp filaments; but a more unusual application has been its use to color and glaze both tea leaves and coffee beans, the pure graphite being a harmless material which protects these against moisture and adds to their attractive appearance.

PRODUCTION AND CONSUMPTION.

The total value of the graphite produced in the United States in 1905 was $318,211, a decrease of $3,161 from the corrected value of the 1904 output, but with a considerable increase in quantity.

The production of crystalline graphite in the States of New York and Pennsylvania in 1905 was 6,036,567 pounds, with a reported value of $237,572, an increase in quantity of 355,390 pounds, but a decrease in value of $875, as compared with the figures of the previous year. This brings the average price per pound slightly below 4 cents, as against 4⅕ cents in 1904. This average price means little, as the range of reported values was between 3⅕ and 7½ cents. The statistics of production also fail to indicate fully the activity in the mining of crystalline graphite, as the tonnage of crude graphite reported as mined but not refined is not included in the totals given.

The graphite produced in the States of Georgia, Wisconsin, Michigan, Alabama, North Carolina, Rhode Island, Colorado, and Nevada has generally been classed together as amorphous. The variation in the purity of this so-called amorphous graphite is extreme, some like that of Colorado and Alabama being essentially crystalline and of high grade, while the graphite mined in Georgia is an impure graphitic schist. The total quantity mined in the States mentioned, which rank as producers on the basis of tonnage in the order given, was 21,953 short tons, valued at $80,639, as against 16,927 tons, valued at $82,925, the revised statistics of production for 1904. The average price per ton determined from these figures would be misleading, inasmuch as the reported values range from $1.25 to over $100 per ton.

In value of product New York leads with a production nearly equaling the rest of the country combined. Pennsylvania is second in rank, followed by Wisconsin, Georgia, Alabama, and Michigan in the order named.

The following table includes the statistics of graphite produced in the United States and of graphite imported into this country since 1900. In the statistics of domestic production the refined crystalline product is given in pounds, and the amorphous graphite and the imports in short tons.

Production and imports of natural graphite, 1901-1905.

Production.				Imports.		
Year.		Quantity.	Value.	Year.	Quantity.	Value.
					Short tons.	
1901	pounds	3,967,612	$167,714	1901	16,044	$895,010
	short tons	809				
1902	pounds	3,936,824	182,108	1902	20,385	1,168,554
	short tons	4,739		1903	17,928	1,207,700
1903	pounds	4,538,155	225,554	1904	14,195	905,581
	short tons	16,591		1905	17,457	983,034
1904	pounds	5,681,177	321,372			
	short tons	16,927				
1905	pounds	6,036,567	318,211			
	short tons	21,953				

This composite table shows the annual consumption of natural graphite in the United States. A small quantity is exported, but probably mostly in the manufactured form. To this consumption of natural graphite, to the value of a million and a quarter of dollars, must be added the output of artificial graphite, the value of which increases this sum by about 25 per cent.

ARTIFICIAL GRAPHITE.

The production of artificial graphite has steadily increased since its introduction upon the market in 1897, and in 1905 the increase was greater than ever before. The quantity of this variety of graphite that was manufactured in 1905 amounted to 4,591,550 pounds, valued at $313,980, which is the largest quantity produced in any year since its first introduction on the market. This is an increase of 1,343,550 pounds in quantity and of $96,190 in value, as compared with the 1904 production. The average price per pound received for the 1905 product was 6.38 cents, bringing the price back to about that of 1903.

In the following table are given the quantities and values of the graphite manufactured for each year since 1897:

Production and value of artificial graphite, 1897-1905.

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	4.69
1903	2,620,000	178,670	6.82
1904	3,248,000	217,790	6.70
1905	4,591,550	313,980	6.38

It would appear from these statistics that the use of the artificial product is being rapidly extended, and it probably now comes into competition with the natural graphite in many lines of manufacture, especially in the electrical trade. For certain purposes, however, it seems certain that nothing can take the place of the mineral, and that the production of crystalline graphite in this country will steadily increase.

WORLD'S PRODUCTION.

In the following table is shown the world's production of graphite, by countries, in 1903 and 1904:

World's production of graphite, 1903 and 1904.

[Short tons.]

Country.	1903.		1904.	
	Quantity.	Value.	Quantity.	Value.
United States	18,860	$225,554	19,768	$321,372
Austria	32,616	382,148	31,584	386,082
Canada	728	23,745	452	11,760
Ceylon	[a] 26,998	1,952,529	[a] 29,187	2,110,873
France	139	689	17	130
Germany	4,099	35,411	4,171	40,122
India	3,801	82,474	3,647	81,288
Italy	8,730	28,855	10,764	44,542
Japan	126	10,950	....	....
Mexico	1,548	41,635	1,069	47,436
Sweden	28	988	61	1,755
Total	97,673	2,784,978	105,923	3,042,199

[a] Exports.

LITHIUM MINERALS.

By Edmund Otis Hovey.

SOURCES.

Practically the only minerals which have been mined as ores of lithium have been amblygonite, lepidolite, and spodumene. Amblygonite, the phosphate of lithium, contains the highest percentage of the metal, but on account of its less abundant occurrence is of less importance than the other two, which are silicates.

Amblygonite has been found in commercial quantities only near Pala, San Diego County, Cal. The mineral was found here in 1902, but was not mined until 1904, and the production seems to have fallen off again completely in 1905.

San Diego County is also the sole region in the United States where lepidolite, or lithia mica, is produced in commercial quantities, and the principal mines are in the vicinity of Pala. Two other localities where lepidolite is abundant are known in this county, one of which is near Banner and the other near Julian. No work other than assessment work was done in 1905 in any of the San Diego lithia mines, with the exception of one, and that produced only 21 tons of ore.

The spodumene mines are located in Pennington County, S. Dak., the principal occurrence of the mineral being at the Etta mine, near Keystone, where the spodumene occurs in enormous crystals, which lie at all angles in an extremely coarse pegmatite carrying small quantities of the cassiterite (oxide of tin), which led to the original opening of the mine. Crystals of spodumene have been measured in this mine which were 30 feet long and about 30 inches in diameter.

Most of the lepidolite which has been mined in the United States has been sent to foreign countries for use, but nearly all of the spodumene has been taken by domestic chemical manufacturers.

USES.

The principal use of lithia ores is for the manufacture of the carbonate of lithium, which is utilized in the solid form and in solution for medicinal purposes, principally for the manufacture of the so-called " lithia waters." Lithium salts are used also to a small extent in the manufacture of compounds for the production of colored fire. The metal tinges a flame with a beautiful shade of red.

PRODUCTION.

For several years there was a great overproduction of lithium minerals under the mistaken impression that there was a large demand for them. There was, however, sharp retrenchment in 1905, and the production fell to practically nothing, being only 21 short tons, valued at $252, all from San Diego County, Cal. During 1904 the production of lithium minerals in the United States amounted to 577 short tons, valued at $5,155, whereas during 1903 the production was 1,155 short tons, valued at $23,425. The mines of Pennington County, S. Dak., which formerly produced the greater part of the lithium ore raised in the United States, were entirely idle during 1905. The present outlook seems to be that no mining of any importance will be done until the stocks of ore now on hand have been considerably depleted.

IMPORTS.

During 1905 there were no imports into the United States of lithium salts, as compared with imports of 19 pounds, valued at $48, in 1904; 5,596 pounds, valued at $3,669, in 1903, and 5,530 pounds of lithium carbonate, valued at $8,038, and 15,686 pounds of other lithium salts, valued at $14,913, in 1902.

The precious spodumene known as kunzite has been mined to some extent and has been cut into gem stones. An illustrated account of the kunzite and lepidolite mines of California, written by Dr. George F. Kunz, was published in 1905 by the California State mining bureau.[a]

[a] Kunz, George F., Gems, Jewelers' Materials, and Ornamental Stones of California: Bull. No. 37, California State Min. Bureau, 1905.

MAGNESITE.

By Charles G. Yale.

PRODUCTION.

The total output of magnesite in the United States continues to come from the State of California, but no increase of moment for the year 1905 is to be noted. The demand for both crude and calcined native material is limited on the Pacific coast, about 3,000 short tons crude per year being all the market will take. The production in 1905 was 3,933 short tons, valued at $15,221. Practically all the supply continues to come from the deposits at Portersville, Tulare County, where they lie close to the railroad. At that point the cost of quarrying is only about 50 cents per ton and hauling to the cars is $1.30, so that the total cost is about $2 per ton. The railroad haul to San Francisco is 275 miles, and the crude may be laid down in that city from the point noted at a total cost of about $5.50 per short ton. Far the larger part is calcined at the mine and shipped to paper factories in Oregon. A smaller portion goes to a liquid carbon-dioxide plant at Sedan, where it is calcined and the gas collected. The residue is sold to the paper mills. The calcined magnesite is valued at from $11 to about $14 per ton.

A number of new deposits have been discovered of late in California, but none of them have become productive except the well-known deposits back of Livermore, Alameda County, owned by the American Magnesite Company, which commenced producing in a small way late in 1905, but the output has not yet become a factor in the markets. The product is hauled 32 miles to railroad in steam wagons and is then shipped to Oakland, where factories have been erected for the manufacture of various products, including magnesite brick. It is expected that in the immediate future these factories will all be in operation.

It has been found impossible to ship the California magnesite profitably to the East, owing to cost of freight. The foreign material sold in New York in 1905 at from $5.50 to $7.25 per ton crude, and at those prices the native product can not compete with the foreign at the points of greatest consumption. Most of the magnesite imported is from Greece, though some of a superior quality is obtained from Austria. Of late the price has increased in New York for foreign crude, the crude Grecian being $6.25 to $7.25 per ton and the calcined $16.75 to $17.75 per ton. This increase is due to several causes: The demand both in Greece and elsewhere has increased; the two principal companies in the island of Eubœa, Greece, have formed a trust or syndicate, thus eliminating competition, and labor at the Grecian quarries has become more expensive. On the island of Eubœa, where the quarries are located, the raw material now costs 19 to 22 francs per ton of 2,240 pounds. Caustic calcined magnesite costs at the same place 67 to 70 francs gold per ton, according to quality. The price includes cost of bags. Dead-burned magnesite brings 5 francs more per ton. Freight must then be paid to New York, which is the market for foreign magnesite in this country. This rise in the price of foreign material is not apt to raise the price in California, because many new deposits have been found there on which work may commence at any time and rapidly cause an increase of production. In fact, one company is now opening new deposits of such a nature and so located that the crude material may be laid down at the factory at a cost of from $3.50 to $4 per ton. Most of the deposits thus far found are so far from railroad lines that the cost of hauling to cars forbids competition, under the present price and conditions, with known deposits handy to railroad stations.

The demand for magnesite brick on the Pacific coast is quite small, and thus far no brick has been made there, though a new factory is about to start operation for the purpose. Other magnesite brick factories in the United States continue to manufacture, though large quantities are imported from Austria. The use of magnesite brick and plaster for furnace lining is increasing in this country.

No magnesia has thus far been made from the native product, though it is about to be manufactured in California. The two factories making light magnesia in Milwaukee, Wis., use for the purpose a dolomite carrying 43½ to 44 per cent of magnesia. They obtain the dolomite laid down for about $4 per ton, while imported magnesite costs at that point $9 to $10 per ton, so that the imported magnesite is not used for this purpose.

Magnesia as an adulterant for paint has not been found as good for the purpose as baryta, as it does not take up oil so readily, and it settles to the bottom in the manufactured paint. As a result the paint men have given up the use of magnesite.

Experience in California shows that the properties nearest the railroads have a distinct advantage over those distant from them, where the home market is limited and the prices realized low. Long hauls by team add so materially to cost that deposits requiring this are now idle. Of some half a hundred known deposits of magnesite in California only two are now being mined, though any marked advance in price or demand would lead to the starting up of several more of the quarries.

The following table gives the quantity and value of crude magnesite produced in the United States from 1891 to 1905, inclusive:

Quantity and value of crude magnesite produced in the United States, 1891–1905.

[Short tons.]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1891	439	$4,390	1899	1,280	$18,480
1892	1,004	10,040	1900	2,252	19,333
1893	704	7,040	1901	3,500	10,500
1894	1,440	10,240	1902	2,830	8,490
1895	2,220	17,000	1903	3,744	10,595
1896	1,500	11,000	1904	2,850	9,298
1897	1,143	13,671	1905	3,933	15,221
1898	1,263	19,075			

IMPORTS.

The imports of magnesite into the United States for 1904 and 1905 were as follows:

Imports of magnesite into the United States in 1904 and 1905.

[Pounds.]

	1904.		1905.	
	Quantity.	Value.	Quantity.	Value.
Magnesia:				
Calcined, medicinal	15,546	$3,190	13,554	$2,778
Carbonate of, medicinal	15,598	1,089	21,901	1,360
Sulphate of, or Epsom salts	4,085,847	18,957	9,039,099	38,084
Magnesite:				
Calcined, not purified	47,143,094	203,816	134,595,334	595,355
Crude	30,265,178	83,012	14,152,466	63,264

In addition, magnesium not made up into articles was imported to the value of $12,190 in 1904, and to the value of $22,205 in 1905.

These imports came from Greece and Austria—mainly from the former country. While the imports of crude magnesite have fallen off one-half, it will be noted that the imports of the calcined have very materially increased. This increase alone amounts to 87,452,240 pounds, or nearly double the total quantity of calcined imported in the previous year. This shows a very large increase of consumption in this country, while the figures of production show that only a small proportion of that used here is mined in the United States. It is not that the mines of California are unable to make a larger output, but that the freight rates from San Francisco to eastern cities are such as to prevent competition with the foreign material at the points of greatest consumption in this country.

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 plaster form for lining furnaces, covering steam pipes, as artificial lumber, as composite stone for lithographing, as an adulterant for paint, etc. The magnesia chloride is an excellent bleaching agent. The light carbonate or magnesia alba levis is used for medicinal and toilet purposes. The sulphate, known as Epsom salts, is mainly used in warp sizing or weighting in cotton mills, and lesser quantities are used for medicinal purposes. The hydrate is used in sugar manufacture.

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. The rolling mills of the Pacific coast all use the material for bottoms in their furnaces. The magnesite bricks made in this country come from the Fayette Manufacturing Company, of Layton, Pa., and the Harbison-Walker Refractories Company, Pittsburg, Pa. A plant has been recently completed by the Rose Brick Company, at East Oakland, Alameda County, Cal., for the manufacture of magnesite brick.

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-named State have the deposits been commercially utilized. The principal producing point in California is still in the vicinity of Portersville, Tulare County, though, as already stated, the mines of the American Magnesite Company at the junction of Alameda, Stanislaus, and Santa Clara counties commenced producing toward the end of the year.

Mr. Frank L. Hess, of the United States Geological Survey, has recently described "Some Magnesite Deposits of California,"[a] after visiting the principal mines in that State. The geological features of occurrence are mentioned, the economic features referred to, and descriptions are given of the methods of burning magnesite and of manufacturing the liquid carbon dioxide.

FOREIGN MAGNESITE AND MAGNESIUM CEMENT.

In accordance with request of American cement manufacturers, instructions were issued by the Government to consular offices at certain foreign points calling for information in regard to magnesite and magnesium cement. The replies are published in the Daily Consular Reports, No. 2276, Department of Commerce and Labor, June 6, 1905.[b] From these consular letters the following information is compiled:

AUSTRIA.

The only company operating magnesite mines in the Vienna district is the Veitscher Magnesitwerke Actiengesellschaft, which has its head office in Vienna. The works and the mines of the company are at Veitsch, about 5 miles from the Mittersdorf-Murzthal Railway station in the province of Styria. This is stated to be the principal company in the world operating magnesite mines. The production of magnesite by this company in the year ending June 30, 1902, was 59,450 tons, and 71,016 tons in the year 1903. This company's exports of calcined magnesite to the United States during the years ending June 30, 1901 and 1902, were 30,000 and 35,000 tons, respectively. Only calcined magnesite is exported.

GREECE.

There are but two companies operating magnesite mines near Athens at the present time, the Anglo-Greek Magnesite Company (Limited), of 24 Finsbury square, London, England, and the Society of Public Works, Athens. The first named operates the magnesite quarries of the Monastery Galataki, on the island of, Eubœa, about 10 miles from the port of Limni, where the magnesite is loaded upon vessels. The output of the quarries of Galataki during 1902 and 1903 was as follows in long tons:

Magnesite output of Galataki quarries, and exports to the United States, 1902 and 1903.

[Long tons.]

Year.	Raw magnesite.		Caustic calcined magnesite.		Dead burnt magnesite.
	Output.	Exported to the United States.	Output.	Exported to the United States.	
1902	14,600	6,647	3,500	578	....
1903	26,300	3,200	3,550	125	1,200

[a] Contrib. to Economic Geology, 1905, Bull. U. S. Geol. Survey No. 285, 1906, pp. 385-392.
[b] Daily Cons. Repts., No. 2276, June 6, 1905.

The Society of Public Works of Athens is working the underground magnesite mines of Mantudi and Limni, on the island of Eubœa, but the records of the consulate show that the company invoiced shipments to the United States amounting to 7,390 tons of magnesite and 98 tons of fire brick in 1902, and 2,335 tons of magnesite in 1903. The Athens agent of the Anglo-Greek Magnesite Company (Limited), Mr. G. F. Haar, states that calcination of magnesite, to produce both caustic and dead burnt, has increased to a large extent, and that about one-half of the output of raw magnesite is now calcined before shipment. The "ton" is of 2,240 pounds. Raw magnesite costs from 19 to 22 francs, gold, per ton of 2,240 pounds, free on board, at the island of Eubœa, where the quarries are located. Caustic calcined magnesite costs, free on board, at Eubœa from 67 to 70 francs, gold, according to the quantity bought. The price includes cost of bags. Dead burnt magnesite brings 5 francs more per ton. The prices of magnesite have recently increased. This is due to several causes: (*a*) The demand, both local and foreign, has grown; (*b*) the two principal companies have formed a trust or syndicate, thus eliminating competition; (*c*) the fall in the exchange has raised the value in gold of the paper drachmas, and has thus rendered labor more expensive.

Freight from Eubœa to New York is 9s. 3d., to Philadelphia 1s. more per ton. The leading purchasers of Greek magnesite are England, Germany, Holland, and France.

In addition to its uses for making or lining metallurgical furnaces for the process of making Bessemer steel, for manufacturing artificial cement from magnesium soils, for making fire brick, etc., magnesite is now being used as a source of carbonic acid for aerated waters, and the demand for it for this purpose is rapidly increasing.

Besides the above-named companies, Mr. B. Boudouris, ex-minister of marine, Athens, is the owner of a magnesite deposit on the island of Eubœa, but he does not work his quarry. Exporters of Greek magnesite have to pay harbor dues and 10 per cent on the net profit obtained from magnesite exported annually.

HUNGARY.

According to the firm of Alexander & Liebermann, forwarding agents and lessees of magnesite mines, the production of magnesite in Hungary in 1903 was only about 7,000 tons, while the productive capacity was 27,000 tons, as follows: Hungarian Magnesite Industry Company (Limited) (formerly Paul Mansfeld), 15,000 tons; Alexander & Liebermann, 5,000 tons; Freund (formerly United Gomor County Company), 4,000 tons; Friedmann, Grunfeld & Co., 3,000 tons; total, 27,000 tons.

The Royal Hungarian mining captain at Iglo furnishes the following list of magnesite mine owners in Hungary:

Budapest.—Alexander & Liebermann; Magnesite Company (Limited); Rimamurany Lalgotarjan Iron Works; Hungarian Magnesite Products Manufacturing Company (Limited).

Hacsava.—Magnesite Industry Company (Limited).

Jolsva.—Aaron Friedmann, Alexander Roth.

Kassu.—People of the city of Kassu.

Nyustya.—United Gomor Magnesite Company (Limited).

Rathko.—Martin Grunfeld, Dr. John Davis.

Szirk.—Hungarian Magnesite Manufacturing Company (Limited).

The average price per ton of crude and calcined magnesite at the mines, which are in Gomor County, with few exceptions, varies according to the situation of the mine with respect to the railroad, the manipulation of the material contracted for, and the fee or per cent of the selling price demanded by the town controlling the mine. At Jolsva, for instance, the Hungarian Magnesite Industry Company (Limited) pays 1.20 crowns (24.36 cents) to the town and charges 1.80 crowns (36.54 cents) per ton for its work in mining the ore; total, 3 crowns (60.90 cents) per ton. To this must be added 2 crowns (40.6 cents) for transportation from the mine to the company's works. From $3\frac{1}{2}$ tons of ore 1 ton of calcined magnesite is prepared, which costs delivered at the Jolsva railway station $6.43. At Nyustya the calcined magnesite of Mr. Freund (formery United Gomor County Company) is quoted at $6.15 per ton, but the product is considered too full of lime and other materials. At Ochtina Messrs. Alexander & Liebermann quote their product at $5.22. Fault was found with their product by a Pittsburg purchaser, and a long-standing contract was canceled, much to the detriment of Hungary's export and the benefit of Greek and Austrian exporters.

In 1903, according to Alexander & Liebermann, the total quantity produced (7,000 tons) was exported. That more was not produced and exported was due to the entire renovation of the Hungarian works, as a result of the complaints of the American buyers.

Preliminary statistics for the year 1903 show an import of 30,423 pounds of crude and 581,353 pounds of calcined magnesite, or a total of 611,776 pounds, valued at $6,449. The exports in 1903 were 6,906,635 pounds, almost all calcined, valued at $92,690. Preliminary statistics for the first quarter of 1904 show an import of 61,288 pounds, chiefly calcined, valued at $638, and an export of 3,751,347 pounds, all calcined, valued at $20,580. The import in 1904 at this rate has fallen to one-tenth of that of 1903.

In Hungary magnesite cement, made of fully calcined ore, and magnesite mortar, made of half-calcined ore, are distinguished. The first is prepared at a temperature of 1,570° to 1,600° Cel., entirely cooled and ground to a fine dust. The second is made at a temperature of only 700 to 750, and is likewise ground. The former is used for lining the bottoms and sides of smelting furnaces, the latter (caustic) for laying the magnesite fire bricks when making such furnace. The cement is prepared by the Hungarian Magnesite Industry Company, at Jolsva, and by Alexander & Liebermann, at Ochtina.

The former company prepares bricks and other products of cement, but the charge has already been made, says Mr. Liebermann, that some of the bricks were made of Freund's magnesite from Hacsava (near Nyustya), and found fragile and not compact. The complaint against the Jolsva bricks has been that they contained too much iron and silicates. The former Pittsburg buyer of Mr. Liebermann's Ochtina bricks purchased some 2,400 tons annually, as the best in the market. Germany also purchased the Ochtina magnesite bricks prepared by the Nyustya company previous to its purchase by Freund. The last-named gentleman has attempted to put on the market technically better bricks, but his efforts are unavailing to win the American trade, so much desired, since there is still 10 to 15 per cent silicates to be found in the bricks. The State statistician still classifies fire bricks as clay wares; hence, there are no official figures as to Hungary's export of magnesite fire bricks.

SOUTH AFRICA.

In the neighborhood of Malelane and Kaapmuiden, 100 miles from Lourenço Marquez, close to the railway line, large deposits of magnesite that is said to equal the best Grecian magnesite have been found, and a company has been formed to work and develop them.

The veins of magnesite are of varied width, in many places being more than 100 feet in thickness, but the central hill near what is known as Salt Creek appears to be one vast deposit about 2,000 feet long by 200 feet wide and upward of 300 feet high. According to the estimate made by the consulting engineer, the deposits of magnesite at this particular point exceed a million tons. The topographical position of the magnesite hills is such that the deposits can be quarried at a very low cost.

MICA.

By George Otis Smith.

INTRODUCTION.

The term mica includes a group of minerals which possess in common certain physical properties by which they are easily recognizable. The brilliancy, ready cleavage, and toughness of mica attracted the attention of the ancients, and from its glistening appearance this mineral derived its name. These properties, which have made mica one of the most widely known minerals, have also determined its economic value. The brilliant luster led to the early use of micaceous minerals for decorative effects, while the perfect cleavage into thin plates possessing elasticity and toughness is a characteristic which fits the mineral for many uses in the arts.

Mineralogically, the micas are aluminous silicates having similar crystal forms and a perfect cleavage. The hardness is between 2 and 3—that is, mica is generally soft enough to be scratched with the finger nail. The more common micas are biotite, the ferromagnesian variety, phlogopite or magnesian mica, muscovite or potash mica, and lepidolite, which contains lithium. The last named is important only as a source of lithia salt for the chemical trade; and biotite, because of its dark color, iron content, and occurrence in smaller plates, has never been extensively used.

The two commercially important micas are muscovite, the white or water mica of the trade, and phlogopite, loosely termed amber mica. Muscovite is usually of a silver gray or light-yellow color, and is very transparent and often almost colorless; exceptionally, however, as in some of the Indian localities, dark red muscovite is found. Phlogopite is of varying shades of brown.

OCCURRENCE.

Few minerals are more universally distributed than the micas, but this wide distribution pertains only to the mineral in flakes and crystals too small to be of value. Both biotite and muscovite occur in igneous and metamorphic rocks, as well as in the sediments derived from the crystalline rocks. Phlogopite appears to be confined to the metamorphic rocks, and generally with relations indicating its igneous origin. Muscovite is the mica mined in the United States and India, while phlogopite is obtained from the Canadian mines.

The source of the commercial muscovite is generally pegmatite dikes. These are vein-like masses largely composed of the granitic minerals, quartz, feldspar, and mica, and are common in most areas of crystalline rocks, whether granites, gneisses, or metamorphosed sedimentary formations. The dikes intrude the country rock, following whatever planes of foliation may be present, or cutting across these and often passing into irregular bodies of considerable size. In these dikes the constituent minerals occur in large crystals, so as to form a "giant granite." The geologic evidence generally supports the view that the pegmatite is really but one type of igneous intrusion, the magma from which it crystallized being characterized by the presence of large quantities of water, which facilitated the formation of these large crystals. The presence of this type of crystallization is, of course, the feature of economic importance, and commercial muscovite of the better grade is confined to the wide pegmatite dikes in which the mica occurs in large crystals or "books."

Phlogopite occurs in dikes associated with pyroxene and apatite. So intimate is this association with the latter mineral that some mines originally worked as phosphate producers later developed into mica mines. The Canadian geologists attribute an igneous origin to the apatite and pyroxene, and therefore regard a similar eruptive origin as plausible for the phlogopite as well.

In considering the value of an occurrence of mica, certain precautions should be taken. The fissile and light character of mica facilitates the easy transportation of large plates by small rivulets, so that the position of "float" mica may be at considerable distance from the ledge from which the mineral was derived. When the outcrop of mica has been discovered, care must be taken not to overestimate the quantity present. Dr. Joseph Hyde Pratt has stated the percentage of mica in pegmatite dikes as varying from 1 to 10 per cent, the winning of which, of course, necessitates the removal of a correspondingly large quantity of waste rock. The ratio of sheet mica to the mica mined is often low, Doctor Pratt's estimate for the average percentage being 10 to 15. This large proportion of scrap mica is caused by several factors. The mining methods may be so crude that excellent material is damaged. Other portions of the mica mined may be rendered valueless by reason of inclusions of iron minerals or of imperfections in color. Considerable mica also possesses planes along which there is an imperfect cleavage, which interrupts the true cleavage. Mica possessing these parting planes is known as "ribbon," "ruled," or "A" mica, and has little or no value as sheet mica.

USES.

The three principal uses of mica are for electrical insulation, glazing, and decoration. The first-named application probably leads in present importance, but the other two uses date back to ancient times, mica antedating glass, and also being early used to secure decorative effects.

As an insulating material, mica occupies a place that can not be filled by any other substance. Its toughness and elasticity has already been mentioned, but equally important characters are its infusibility and softness. As used in dynamo commutators, the latter property is essential, and for this purpose the Indian mica is reported to rank first and the Canadian second. In mica used for electrical purposes light color and transparency are not essential, but the presence of even microscopic inclusions of magnetite renders it much less resistant to punctures by the current.

The increasing use of mica in electrical manufactures has largely modified the demand made upon the mining industry. Small sizes of sheet mica can now be utilized in the manufacture of insulators in lamp sockets, lightning arrestors, switch boxes, and fuse blocks. More important even is the extensive use that is made of composite mica, micanite, molded mica, and other varieties of built-up mica sheets. In the manufacture of material of this class thin laminæ of irregular form and different sizes are arranged and cemented together to form thick sheets of any size desired. Not only can sheet mica of small sizes be thus utilized, but where there are other minerals included between the folia, which might destroy the value of certain sheets, these can be removed in the process of thin splitting. The mica board has largely supplanted the large-size sheets of natural mica in the electrical industry because of several advantages possessed by the built-up material. The lines of molecular weakness which give rise to the percussion and pressure figures in the natural sheets are avoided by the different orientation of the thin films constituting the composite sheet, with the result that the strength is increased as well as the resistance to arc punctures. The use of shellac or other cementing material increases the flexibility of the mica during the process of manufacture, allowing the plates to be molded into a great variety of forms for use in electrical apparatus. Since this material was first introduced its application has been rapidly extended. To-day not only is it used in small sizes in the insulation of electrical apparatus and for covering the handles of electricians' tools, but its strength and resistance to moisture especially fits the molded mica for use in weather-proof lamp sockets and telegraph and feed-wire insulators.

The use of mica for stove windows formerly constituted the principal demand for sheet mica, but this has decreased somewhat in recent years. The increased use of sheet mica in incandescent gas lamps and for miner's lamps has kept up the demand for glazing grades, so that whatever comes into the market is readily bought. Sheet mica is also used to some extent for phonograph diaphrams and in various small boxes and other novelties.

Scrap mica is utilized in the manufacture of a superior quality of boiler lagging, a mat of finely divided mica flakes furnishing a fireproof covering that has sufficient strength to be durable, not disintegrating like some other materials, and excelling asbestos and magnesia compounds as a nonconductor of heat. The superiority of the mica lagging appears to depend not only upon the low conductivity of the mineral itself, but especially upon the loose texture of the mica mat.

Ground mica is used in somewhat increased quantities, the coarser grades in mica bronzes and paints and also as an absorbent for explosives. Ground mica also forms an ingredient in some heavy lubricants. The finest ground mica or mica flour finds a considerable market with the manufacturers of high-grade wall papers, the luster obtained by the use of the muscovite dust having the advantage of both permanency and brilliancy.

PRODUCTION AND CONSUMPTION.

Exact information regarding mica production is difficult to secure, and statistics compiled from the imperfect data are simply approximations. In North Carolina, which for many years has lead in mica production, the returns from the small producers are so unsatisfactory that they must be largely disregarded in the compilation, and the main dependence is placed upon reports received from the larger operators and from the companies which handle the output of the small miners.

During 1905 mica production in the United States was limited to six States—North Carolina, Colorado, New Hampshire, Georgia, South Dakota, and New Mexico, the order named indicating their relative rank.

The total output of sheet mica for these States, as reported to the Survey, was 851,800 pounds, with a total value of $185,900. Of this quantity North Carolina is credited with 669,800 pounds, valued at $85,900. The increase in production over the previous year was largely in the other States, while the larger increase in value may be accounted for in part by high prices reported by producers in those States. A decrease in the average price for the North Carolina product is due to the increasing proportion of small mica produced for electrical uses.

The total production of scrap mica in the United States in 1905 was 856 short tons, valued at $15,255, an increase in value over the production for 1904. North Carolina's output of scrap mica for 1905 was 175 short tons, valued at $2,375. The separation of the production figures for scrap mica and for the smaller sizes of sheet mica becomes more difficult as the use of these small sizes increases.

North Carolina has led in mica production for nearly forty years, New Hampshire being the larger producer prior to that time. The North Carolina mines are believed to have been opened by the Indians. The mining of mica in New Hampshire began at Grafton in 1803. In both States the operations have been conducted mostly on a small scale, the greater part of North Carolina's product coming from many small mines. The demand for mica in that State is reported as good, and a larger output is expected for 1906. In New Hampshire development work was done during 1905 that does not show in the production returns, but is expected to increase largely the output for 1906. At Alexandria, N. H., several mines are being opened and equipped with machinery. The plan of operation includes also a mill for grinding the quartz and feldspar as well as the scrap mica, thus utilizing all the by-products.

Among the Western States Colorado has become a producer of importance, and development work is reported in a number of States.

In view of the steady demand for sheet mica of the glazing grade, the promise is good for continued activity in the North Carolina mines, which furnish the best mica of that grade. The New Hampshire mines possess an advantage in proximity to the chief markets for the smaller sizes of sheet mica for electrical use and for ground mica, in the price of which the item of transportation forms so important a part.

The following table includes the statistics of mica mined in the United States and of mica imported into this country since 1900:

Annual production and imports of mica in the United States, 1900–1905.

Production.			Imports.		
Year.	Quantity.	Value.	Year.	Quantity.	Value.
1900.	*Pounds.*		1900.	*Pounds.*	
Sheet	456,283	$92,758	Unmanufactured	1,892,000	$290,872
Scrap	[a] 5,497	55,202	Cut or trimmed	64,391	28,688
Total		147,960	Total	1,956,391	319,560
1901.			1901.		
Sheet	360,060	98,859	Unmanufactured	1,598,722	299,065
Scrap	[a] 2,171	19,719	Cut or trimmed	78,843	35,989
Total		118,578	Total	1,677,565	335,054
1902.			1902.		
Sheet	373,266	83,843	Unmanufactured	2,149,557	419,362
Scrap [b]	[a] 1,400	35,006	Cut or trimmed	102,299	46,970
Total		118,849	Total	2,251,856	466,332
1903.			1903.		
Sheet	619,600	118,088	Unmanufactured	1,355,375	288,783
Scrap [b]	[a] 1,659	25,040	Cut or trimmed	67,680	29,186
Total		143,128	Total	1,423,055	317,969
1904.			1904.		
Sheet	668,358	109,462	Unmanufactured	1,085,343	241,051
Scrap	[a] 1,096	10,854	Cut or trimmed	61,986	22,663
Total		120,316	Total	1,147,329	263,714
1905.			1905.		
Sheet	851,000	185,900	Unmanufactured	1,506,382	352,475
Scrap	[a] 856	15,255	Cut or trimmed	88,188	51,281
Total		201,155	Total	1,594,570	403,756

[a] Short tons. [b] Includes rough as mined or unmanufactured.

These statistics indicate an increase in the consumption of sheet mica the past year in the United States of over 30 per cent, making the 1905 consumption greater than that of any previous year except 1902. The imported mica comes from Canada and India, this country taking about one-half of the output of the Canadian mines. Ground mica of Canadian origin is not imported on account of the tariff.

PRICES.

Average prices determined from the foregoing production table would afford poor data for any valuation of mica, inasmuch as the prices vary widely for the different sizes. In North Carolina the values reported by dealers range from 40 cents and 25 cents per pound for stove mica down to 5 cents and less for electrical mica. Cirkel, in his recent report on the mica of Canada, quotes prices for medium-quality Canadian muscovite as ranging from 12 cents per pound for 1 inch by 3 inches, thumb trimmed, to $1 for sheets 4 by 6 inches; for phlogopite the prices quoted for the same sizes are 10 cents and 75 cents, respectively. The combined specific duty of 6 cents and ad valorem duty of 20 per cent on rough-trimmed mica would aggregate from 80 to 25 per cent of these prices, respectively.

Scrap mica is valued at from $5 to $10 a ton in both the United States and Canada. The duty prevents importation of either the Canadian scrap or ground mica. The latter is quoted at from 5 to 10 cents a pound, but the ground phlogopite lacks the luster of the muscovite.

The present condition of the industry in this country is that the demand is good for the larger sizes of sheet mica for glazing purposes, for which use the muscovite is superior to the darker-colored micas of India and Canada; the smaller sizes of sheet can be cut into electrical mica, and the waste mica is available for the manufacture of micanite and other varieties of built-up mica board and also for grinding into the various grades of ground mica and mica flour. Thus the run of the mine can be utilized to a greater extent probably than ever before.

MINERAL WATERS.

By Myron L. Fuller.

REVIEW OF MINERAL-WATER TRADE IN 1905.

GENERAL CONDITIONS.

The year 1905 was, on the whole, a moderately prosperous one as regards the mineral-water trade. It is true that the production fell off considerably in a number of those States which have been classed as the leading producers, the decrease being especially marked in California, Massachusetts, and New York. On the other hand, the output has largely increased in Indiana, Minnesota, Pennsylvania, Tennessee, and Texas, and to a lesser extent in many other States. In fact, 30 States or Territories have reported increased sales during the year, while only 15 have fallen below the output of the previous year.

Considering the country as a whole, there was a net increase of reported production in 1905 of 4,575,216 gallons over that of 1904. The following table gives an analysis of the changes in production in 1905, including the increase or decrease in the number of springs over 1904, the variation in the number of gallons sold, and changes in the value of the product. The figures given are based solely on the springs from which information has been received either directly or indirectly, it being considered undesirable and misleading to include in State totals estimates of output of springs which have not been heard from and which may not be producing. For the purpose of obtaining the grand total for the country, however, estimates of the outputs of a number of delinquent springs believed to be still producing are embodied. In comparing outputs of different years such estimates are also included.

Comparative production of mineral waters in 1904 and 1905.

State or Territory.	Increase in number of springs reporting.	Decrease in number of springs reporting.	Increase in gallons sold.	Decrease in gallons sold.	Increase in value of product.	Decrease in value of product.
Alabama	1		39,379		$19,364	
Arkansas	2			60,435		$6,606
California	4			1,821,995		224,549
Colorado	2		123,522		9,918	
Connecticut	2			73,985		13,828
Florida	5		131,420		24,030	
Georgia	1			35,045		8,125
Illinois		3	32,950		9,899	
Indiana	7		498,943		58,697	

Comparative production of mineral waters in 1904 and 1905—Continued.

State or Territory.	Increase in number of springs reporting.	Decrease in number of springs reporting.	Increase in gallons sold.	Decrease in gallons sold.	Increase in value of product.	Decrease in value of product.
Iowa	Same.		189,500		$14,600	
Kansas		1	18,700		638	
Kentucky	Same.		107,970		10,876	
Maine	6			368,168		$181,924
Maryland	Same.		40,014		307	
Massachusetts	3			1,011,805		145,066
Michigan		2		700,875	158,766	
Minnesota	2		6,779,150		111,425	
Mississippi	3			26,131		6,911
Missouri		3	137,546		23,739	
New Hampshire	Same.		91,490		14,772	
New Jersey	1		205,610		20,527	
New York		1		732,639		130,564
North Carolina	3		35,200		11,842	
Ohio	10			280,841	11,167	
Oregon	1			27,764		5,189
Pennsylvania	6		579,544		103,648	
Rhode Island	Same.		4,758			7,101
South Carolina	2		7,345			1,578
Tennessee	1		939,301		89,812	
Texas	14		384,470		79,498	
Vermont	Same.		10,000		1,200	
Virginia	2		222,857		267,104	
Washington	Same.		5,100			479
West Virginia	2		35,188		34,423	
Wisconsin	2		70,000			91,820
States or Territories not included above: Arizona, District of Columbia, Idaho, Indian Territory, Louisiana, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, South Dakota, and Wyoming (net gain)	8			975,065	19,866	
Total	90	10	10,689,967	6,114,751	1,096,118	823,740
Net increase	80		4,575,216		272,378	

A study of the returns received from the spring owners shows that the falling off in production was confined mainly to the large producers, the smaller ones holding their own or even showing an increase of trade. The general satisfactory condition of this small trade is shown especially by the large increase in the number of springs reporting during 1905 (see table, p. 10), the returns being 80 in excess of the number reporting in the previous year. Not only is it the small producers which have shown the largest gains, but it is the States having the greatest number of such producers that show the most marked increase in production.

The causes tending to decreased output of the larger springs are widespread. Perhaps the most important was the abundant rainfall which, taking the country as a whole, characterized the summer of 1905 as compared with the summer of 1904, in the former of which severe droughts were felt in nearly all of the Eastern and Central States, causing a general failure of wells and springs and the deterioration of the quality of many city supplies, all of which tended to lead to a greater demand for mineral waters than in the succeeding more humid year. In the States affected by yellow fever the quarantine tended to decrease the shipments to other States, but seems to have led to an increased demand for table waters for local consumption in the cities. In a few cities, as at Minneapolis, the pollution of the public water supplies or other similar causes led to a greatly increased use of table waters, while in other localities, as at Brockton, in Massachusetts, the introduction of better city supplies led to a material falling off of the mineral-water business. Some springs, from which large quantities of water have previously been taken and sold, have during the year been turned into public supplies, still further lowering the output credited to the mineral-water trade. On the whole the outlook is encouraging, the use of mineral waters is growing, and the number of springs furnishing waters for the market increasing.

PRODUCTION.

In 1905, for the first time, the attempt has been made to differentiate table and medicinal waters and to present statistics as to the use of springs as resorts and for bathing. It is difficult to draw a line between table and medicinal waters, as many are used for both purposes, and the shipper often has no means of determining the proportion applied to each. In nearly all cases the estimates of the owners have been taken, and where these have not been furnished the waters have been classified according to composition or price. Where the price is the basis of classification, the locality has also been considered. Medicinal waters in the North rarely bring less than 25 cents per gallon, but in the Southern States much water selling even as low as 10 cents or less per gallon is used for medicinal purposes.

The following table, which includes only output and sales actually reported, gives a summary of the mineral water production in 1905, including the number of springs reporting, the number of gallons sold, the average price per gallon, and the value of both medicinal and table waters. The last three are included in the mineral-water report for the first time.

Production and value of mineral waters in 1905, by States.

State or Territory.	Number of springs reporting.	Quantity sold.	Average price per gallon.	Value of medicinal waters.	Value of table waters.	Total value of mineral waters.
		Gallons.	*Cents.*			
Alabama	7	57,269	41	$20,321	$3,383	$23,704
Arkansas	7	474,005	11	31,001	19,500	50,501
California	39	1,934,784	35	529,889	145,325	675,214
Colorado	14	903,600	14	29,903	100,720	130,623
Connecticut	8	205,115	11	4,250	19,112	23,362
Florida	8	140,920	20	28,170	....	28,170
Georgia	8	270,249	14	34,625	2,994	37,619
Illinois	11	425,750	11	8,997	38,998	47,995
Indiana	23	897,175	48	429,992	5,190	435,182
Iowa	3	303,500	10	31,300	....	31,300
Kansas	15	213,050	22	43,068	4,640	47,708
Kentucky	5	383,750	11	29,541	12,874	42,415
Louisiana	2	774,652	8	16,337	45,769	62,106
Maine	29	1,167,787	21	132,740	113,419	246,159
Maryland	5	456,214	10	18,152	26,475	44,627
Massachusetts	59	4,202,263	5	19,995	188,424	208,419
Michigan	17	2,684,800	10	38,900	238,288	277,188
Minnesota	6	7,681,650	$1\frac{1}{2}$	1,645	131,325	132,970
Mississippi	9	306,000	17	23,847	29,500	53,347
Missouri	15	470,750	16	61,830	15,650	77,480
New Hampshire	5	813,050	24	172,250	25,100	197,350

Production and value of mineral waters in 1905, by States—Continued.

State or Territory.	Number of springs reporting.	Quantity sold.	Average price per gallon.	Value of medicinal waters.	Value of table waters.	Total value of mineral waters.
		Gallons.	*Cents.*			
New Jersey	10	394,060	12	$5,570	$39,827	$45,397
New Mexico	6	75,500	21	4,415	11,605	16,020
New York	40	5,619,878	12	169,079	483,601	652,680
North Carolina	10	181,000	18½	30,000	3,744	33,744
Ohio	23	943,114	12	25,187	92,546	117,733
Oregon	9	33,085	25	7,872	235	8,107
Pennsylvania	27	1,322,594	14½	111,952	82,161	194,113
Rhode Island	4	210,830	7	5,250	10,219	15,469
South Carolina	7	358,830	22	60,222	18,615	78,837
Tennessee	14	1,254,018	11	120,835	15,026	135,861
Texas	28	1,526,970	9	123,971	20,450	144,421
Vermont	6	73,000	28	4,000	16,550	20,550
Virginia	37	2,340,287	23	399,091	150,011	549,102
Washington	4	30,000	33⅓	4,589	5,512	10,101
West Virginia	6	90,728	55	50,063	....	50,063
Wisconsin	27	6,656,834	22	240,613	1,214,102	1,454,715
States or Territories not included above: Arizona, District of Columbia, Idaho, Indian Territory, Montana, North Dakota, Oklahoma, South Dakota, and Wyoming	11	667,300	13½	64,080	26,819	90,899
Total	564	46,544,361	14⅗	3,133,542	3,357,709	6,491,251

To the production above recorded, which includes only the output and sales actually reported, should be added the estimated output of certain delinquent springs. These, in 1905, numbered 167, of which 35 reported sales in 1904, with an aggregate volume of 1,568,580 gallons, valued at $480,552. On the assumption that these springs are still producing, and that their output for 1905 is two-thirds that of the previous year, the following total estimate is obtained by adding their number and output to the totals of the preceding table:

Total estimated production of mineral waters in 1905.

	Number of springs.	Quantity sold.	Value.
		Gallons.	
Springs reporting	564	46,544,361	$6,491,251
Delinquent springs	167	1,045,720	320,360
Total	731	47,590,081	6,811,611

STATE OF TRADE.

The condition of the mineral-water trade in 1905 as compared with 1904 has already been mentioned. Briefly, there was an increase of 80 in the number of springs reporting sales, a net increase in production actually reported of 4,575,216 gallons, and an increased value of reported sales of $272,378.[a] If the estimate for the

[a] Excluding 16,995,000 gallons, valued at $3,200,000, not used as mineral waters, but included in 1904 report.

delinquent springs is taken into account, however, there has been a loss of 3,133,419 gallons and a decrease of $386,839 in the value from the estimated product for 1904. On the same basis the output for 1905 would appear to be less than that for any year since 1899. In reality, however, the output has probably been exceeded only in the banner years 1901 and 1902, the actual reported sales in 1905 being greater than those of all other years. In fact, the returns, which form the most reliable basis for comparison, not only show no decrease in value, but indicate a steady increase of output during the last three years. The number of producing springs is more than three times as great as it was twenty years ago, and nearly twice as great as ten years ago. If the average rate of increase continues, mineral springs will soon take their place among the leading resources of our country. The following table gives the number of springs and the output and value of mineral waters of the country as a whole from 1883, when statistics were first collected by the Survey, down to 1905, inclusive:

Estimated production of mineral waters, 1883–1905.

Year.	Number of springs.	Quantity sold.	Value.	Year.	Number of springs.	Quantity sold.	Value.
		Gallons.				*Gallons.*	
1883	189	7,529,423	$1,119,603	1898	484	28,853,464	$8,051,833
1884	189	10,215,328	1,459,143	1899	541	39,562,136	6,948,030
1885	224	9,148,401	1,312,845	1900	561	[a] 45,276,995	[a] 5,791,805
1886	225	8,950,317	1,284,070			47,558,784	6,245,172
1887	215	8,259,609	1,261,463	1901	659	[a] 54,733,661	[a] 7,443,904
1888	198	9,578,648	1,679,302			55,771,188	7,586,962
1889	258	12,780,471	1,748,458	1902	721	[a] 63,174,552	[a] 8,634,179
1890	273	13,907,418	2,600,750			64,859,451	8,793,761
1891	288	18,392,732	2,996,259	1903	725	[a] 40,107,147	[a] 6,788,426
1892	283	21,876,604	4,905,970			51,242,757	9,041,078
1893	330	23,544,495	4,246,734	1904	738	[a] 41,969,145	[a] 6,218,873
1894	357	21,569,608	3,741,846			[b] 50,723,500	[b] 7,198,450
1895	370	21,463,543	4,254,337	1905	732	[a] 46,544,361	[a] 6,491,251
1896	377	25,795,312	4,136,192			47,590,081	6,811,611
1897	441	23,255,911	4,599,106				

[a] Quantity actually reported.
[b] Excludes 14,995,000 gallons, valued at $3,000,000, turned into public supplies but included in original estimate for 1904, and 2,000,000 gallons, valued at $200,000, used otherwise than as mineral water.

The following table supplements the preceding by giving the reporting number and the total number of springs, and the quantity and the value of mineral waters reported sold for each State during the last two years:

Number of mineral springs, quantity and value of mineral waters sold in 1904 and 1905.

State or Territory.	1904.				1905.			
	Springs reporting.	Total springs.	Quantity.	Value.	Springs reporting.	Total springs.	Quantity.	Value.
			Gallons.				*Gallons.*	
Alabama	6	9	17,890	$4,340	7	10	57,269	$23,704
Arizona	3	4	2,850	233	1	4		
Arkansas	5	8	534,440	57,107	7	8	474,005	50,501
California	35	44	3,756,779	899,763	39	47	1,934,784	675,214
Colorado	12	19	780,078	120,705	14	19	903,600	130,623
Connecticut	6	15	279,100	37,190	8	15	205,115	23,362
District of Columbia	0	3			2	3		

Number of mineral springs, quantity and value of mineral waters sold in 1904 and 1905—Continued.

State or Territory.	1904. Springs reporting.	Total springs.	Quantity.	Value.	1905. Springs reporting.	Total springs.	Quantity.	Value.
			Gallons.				*Gallons.*	
Florida	3	5	9,500	$4,140	8	9	140,920	$28,170
Georgia	7	10	305,294	45,744	8	11	270,249	37,619
Idaho	1	1			1	1		
Illinois	14	21	[a] 392,800	[a] 38,096	11	18	425,750	47,995
Indiana	16	24	398,232	376,485	23	28	897,175	435,182
Indian Territory	1	1			1	1		
Iowa	3	7	114,000	16,700	3	7	303,500	31,300
Kansas	16	18	194,350	47,070	15	16	213,050	47,708
Kentucky	5	5	275,780	31,539	5	5	383,750	42,415
Louisiana	1	3			2	3	774,652	62,106
Maine	23	30	1,535,955	428,083	29	30	1,167,787	246,159
Maryland	5	8	416,200	44,320	5	10	456,214	44,627
Massachusetts	56	70	5,214,068	353,485	59	70	4,202,263	208,419
Michigan	19	28	3,385,675	118,422	17	26	2,684,800	277,188
Minnesota	4	6	902,500	21,545	6	6	7,681,650	132,970
Mississippi	6	9	332,131	60,258	9	10	306,000	53,347
Missouri	18	26	333,204	53,741	15	25	470,750	77,480
Montana	1	3			1	2		
Nebraska	0	1			1	1		
Nevada	0	1			0	1		
New Hampshire	5	6	721,560	182,578	5	5	813,050	197,350
New Jersey	9	15	188,450	24,870	10	15	394,060	45,397
New Mexico	1	7			6	7	75,500	16,020
New York	41	60	6,352,517	783,244	40	54	5,619,878	652,680
North Carolina	7	13	145,800	21,902	10	14	181,000	33,744
North Dakota	1	1			1	1		
Ohio	13	25	[b] 1,223,958	[b] 106,566	23	24	943,114	117,733
Oklahoma	1	2			1	2		
Oregon	8	10	60,849	13,296	9	11	33,085	8,107
Pennsylvania	21	35	743,050	90,465	27	35	1,322,594	194,113
Rhode Island	4	4	206,072	22,570	4	4	210,830	15,469
South Carolina	5	11	351,485	80,415	7	11	358,830	78,837
South Dakota	0	2			1	2		
Tennessee	13	14	314,717	46,049	14	15	1,254,018	135,861
Texas	14	31	1,142,500	64,923	28	32	1,526,970	144,421
Utah	1	3			0	2		
Vermont	6	6	63,000	19,350	6	6	73,000	20,550
Virginia	35	59	2,117,420	281,998	37	51	2,340,287	549,102
Washington	4	4	24,900	10,580	4	4	30,000	10,101
West Virginia	4	11	55,540	15,640	6	11	90,728	50,063
Wisconsin	25	38	6,586,834	1,546,535	27	38	6,656,834	1,454,715
Wyoming	0	2			1	1		
States or Territories of one spring each, including those for which figures are not given in the above list			2,489,667	148,926			667,300	90,899
Total	484	738	[c] 41,969,145	6,218,873	564	731	46,544,361	6,491,251

[a] Excludes 14,995,000 gallons, valued at $3,000,000, turned into city supply, but included in 1904 report.
[b] Excludes 2,000,000 gallons, valued at $200,000, used for purposes other than for medicinal or table waters or for beverages, but included in 1904 report.
[c] Exclusive of 16,995,000 gallons, valued at $3,200,000, not used as mineral waters.

TRADE OUTLOOK.

Table waters.—The trade outlook, judging from the figures, would appear to be fairly promising, a steady, healthy growth being looked for rather than sudden expansion. The people are rapidly being educated to demand better public supplies, and if these are not promptly furnished recourse will undoubtedly be had to spring waters for table purposes. It is, in fact, in the use of such waters that the most rapid increase is to be expected. Of course, as purer public supplies are introduced the local demand for table water falls off, but usually this is more than counterbalanced by increased demands elsewhere. Not only will table water be extensively utilized where the city supplies are polluted, but their use will be extended to those cities whose supplies, though not contaminated, are unsightly by reason of sediment or distasteful because of algous growth.

Medicinal waters.—Few if any countries can surpass the United States in the variety of its mineral waters and in their medicinal properties. Their possibilities are very great and will undoubtedly be more extensively appreciated as time goes on. Unfortunately, for the mineral-water trade at least, the American people are relatively little given to the mineral-water treatment alone, and to bring about an increased use of springs for therapeutic purposes attractive resorts must be provided. This has been done in many instances, with the result that in some places, as at Hot Springs, Ark., the attendance rivals or even excels that of many of the famous European springs. The use of mineral waters for bathing purposes, especially in connection with sanitariums, has already become of much importance and will become still more so in the near future. Likewise the use of bottled waters for medicinal purposes will undoubtedly increase as the therapeutic value of American waters becomes better known. The effort of the Agricultural Department to publish accurate analyses of the leading spring waters now sold on the market should do much to improve the mineral-water trade by furnishing physicians and others with the accurate information as to composition which is essential for the successful treatment of disease by means of mineral waters.

TRADE BY STATES.

ALABAMA.

The mineral-water trade in Alabama was very prosperous during 1905. The waters of one new spring, the Opelika Mineral Springs, were placed on the market during the year, which brought the number of commercial springs in the State up to 10. Not only were new springs opened, but the output of the old springs showed a notable increase, the number of gallons sold in 1905 being nearly three times the number sold during the preceding year, while the value of the water was more than five times as great. The increase is due almost wholly to the general growth of the trade. Five of the springs are reported to be used as resorts, having accommodations for over 400 people, and one is said to be used for bathing purposes. The 7 springs reporting sales in 1905 are given below:

Bailey Springs, Florence, Lauderdale County.
Healing Springs, Healing Springs, Washington County.
Ingram Lithia Springs, near Ohatchee, Calhoun County.
MacGregor Spring, Spring Hill, Mobile County.
Magnolia Spring, Magnolia Spring, Baldwin County.
Opelika Mineral Water, Opelika, Lee County.
Wilkinson Matchless Mineral Well, Greenville, Butler County.

ARIZONA.

The conditions in Arizona were slightly less favorable than those during the preceding year. Returns received from each of the 4 springs showed that only one of them is at present producing, the increase in the output of this spring being more than counterbalanced by the absence of reported sales from other springs. The spring reporting is stated to be the site of a resort having accommodations for 200 people and conveniences for bathing. This spring is:

Castle Hot Springs, Hot Springs, Yavapai County.

ARKANSAS.

The mineral-water trade in this State remains very nearly the same as in 1904, the springs putting water on the market still being 8 in number, of which 7 report sales. This number is 1 more than in 1904, but there has been a distinct falling off of certain springs at the large resorts, giving rise to a net loss in the output and value of about 11 per cent. Resorts are located at 7 of the springs, with aggregate accommodations for several thousand people. Facilities for bathing are provided at 4 of them. The springs reporting sales are as follows:

Allen Alterative Magnesian Spring, Hot Springs, Garland County.
Arkansas Lithia Spring, near Hope, Hempstead County.
Arsenic Spring, Hot Springs, Garland County.
Mountain Valley Springs, Mountain Valley, Garland County.
Ozarka Spring, Eureka Springs, Carroll County.
Potash Sulphur Spring, Lawrence, Garland County.
Ravenden Springs, Ravenden Springs, Randolph County.

CALIFORNIA.

There was a falling off of about one-half in the production of mineral waters in this State during 1905, the loss being distributed over a large number of springs. A number of other springs were abandoned. On the other hand 4 new springs reported sales for the year—the Crystal Rock Wells, I-ador-a, McDowell, and Sausalito springs, while a number of others which did not put water on the market in 1904 produced considerable quantities in 1905. Many of the springs also report increased outputs. All but one-fifth of the output is sold for medicinal purposes. Twenty-six of the springs are said to be used as resorts, with accommodations for over 5,000 people. At 16 springs the water is used for bathing purposes. The 39 springs reporting sales are as follows:

Ætna Spring, Lidell, Napa County.
Alder Glen Spring, Cloverdale, Sonoma County.
Alhambra Spring, New Martinez, Contra Costa County.
Allen Springs, Allen Springs, Lake County.
Bartlett Springs, in Coast Range, Lake County.
Blair's Mineral Spring, near Mono Lake, Mono County.
Bradley Spring, near Ramona, San Diego County.
Buckman Spring (California Club Water), 4 miles south of Pine Valley, San Diego County.
Bythinia Spring, Santa Barbara, Santa Barbara County.
California Geysers, The Geysers, Sonoma County.
Castalian Spring, Inyo County.
Castle Rock Springs, Castle Rock, Shasta County.
Cook Spring, 28 miles west of Williams, Colusa County.
Crystal Rock Wells, Orange, Orange County.
Duncan Springs, Hopland, Mendocino County.
Fouts Spring, Snow Mountain, Colusa County.
I-ador-a Spring, Napa County.
Isham Springs, 12 miles east of San Diego, San Diego County.
Lytton Spring, Lytton, Sonoma County.
McDowell Spring, Hopland, Mendocino County.
Mercy Hot Spring, Fresno County.
Mount Ida Mineral Spring, Oroville, Butte County.
Napa Soda Spring, Napa Valley, Napa County.
Pacific Congress Spring, Saratoga, Santa Clara County.
Samuel Soda Spring, near St. Helena, Napa County.

San Benito Spring, Tres Pinos, San Benito County.
Sausalito Spring (near San Francisco?).
Seltzer Springs, Highland Springs, Lake County.
Shasta Spring, Shasta Springs, Siskiyou County.
Soda Spring, Monterey County.
Tassajara Hot Spring, Monterey County.
Tia Juana Spring, Tia Juana, San Diego County.
Tolenas Spring, 6 miles south of Suisun, Solano County.
Tuscan Spring, 9 miles from Red Bluff, Tehama County.
Veronica Spring, Santa Barbara, Santa Barbara County.
Vesper Soda Spring, near Dunsmuir, Siskiyou County.
Vichy Springs, Napa, Mendocino County.
White Sulphur Spring, Eden Hot Springs, Riverside County.
Witter Medical Spring, Witter, Lake County.

COLORADO.

The mineral water report in this State has been fairly prosperous during the year. The number of springs reporting sales is one more than last year, making a total of 13, while the output shows an increase of about 16 per cent. The price per gallon, however, has averaged somewhat lower, so that the increase in value is only about 8 per cent. About three-fourths of the water is used for table purposes, the remainder being for medicinal use. Resorts, having accommodations for several thousand people, are located at 7 of the springs, but none of the waters are reported to be used for bathing purposes. The 14 springs for Colorado are as follows:

Blue Ribbon Mineral Spring, Idaho Springs, Clear Creek County.
Boulder Springs, Boulder Canyon, Boulder County.
Canyon City Vichy Spring, Canyon, Fremont County.
Clark Magnetic Mineral Spring, near Pueblo, Pueblo County.
Colorado Lithia Well, Pueblo, Pueblo County.
Columbia Spring, Denver, Denver County.
Glaze Spring, Olney, Otero County.
Glenwood Hot Springs, Glenwood Springs, Garfield County.
Golden Lithia Spring, Golden, Jefferson County.
Manitou and Cheyenne Springs, Manitou, El Paso County.
Strontia Spring, Strontia, Douglas County.
Ute Chief Spring, Manitou, El Paso County.
Ute Iron Spring, Manitou, El Paso County.
Yampah Spring, Glenwood Springs, Garfield County.

CONNECTICUT.

The trade conditions in Connecticut have been somewhat less satisfactory than in the previous year, there having been a falling off of about one-fourth in the output and of one-third in the value, notwithstanding that the number of springs reporting is 2 more than last year. The falling off is to be attributed to the lessened demand for table water owing to the more satisfactory condition of certain public supplies as compared with their condition in the period of drought of the preceding year. About one-fifth of the water is used for medicinal, the remaining four-fifths for table purposes. One of the springs is reported to be the site of a resort, with accommodations for about 80 people. None of the waters are used for bathing purposes. The 8 springs reporting sales are as follows:

Arethusa Spring, Seymour, New Haven County.
Cherry Hill Spring, Hamden, New Haven County.
Granite Rock Spring, Higganum, Middlesex County.
Highland Park Spring, Highland Park, Hartford County.
Oxford Springs, New Haven County.
Pequabuck Mountain Spring, Bristol, Hartford County.
Stafford Spring, Stafford Springs, Tolland County.
Varuna Spring, North Stamford, Fairfield County.

DISTRICT OF COLUMBIA.

The mineral water trade appears to have been fairly satisfactory during the year, the number of springs reporting sales being 2 more than in 1904. The increased demand was probably due to the pollution of the city supply and the resultant typhoid outbreak. The waters of the two springs reporting are used entirely for domestic purposes. The springs are as follows:

Gitchie Crystal Spring.
Grimes Crystal Spring.

FLORIDA.

The year 1905 has been the most prosperous one yet seen as regards the mineral water trade. Four new springs, Espiritu Santo, Green, Newport White Sulphur, and Suwannee reported for the first time, the total number putting water on the market being 5 more than in 1904. The output is nearly fifteen times as great as the preceding year and several times as great as that of any previous year. The increase is due both to the energetic exploitation of a few large springs and to the placing on the market of the new waters. Practically all of the water is used for medicinal purposes. Seven of the springs are the sites of resorts, at which over 2,000 people can be accommodated. The water at 5 of the springs is said to be used for bathing purposes. The following 8 springs report sales:

Espiritu Santo Spring, near Tampa, Hillsboro County.
Green Springs, on Old Tampa Bay, Hillsboro County.
Magnolia Spring, Magnolia Springs, Clay County.
Newport Sulphur Spring, Newport, Wakulla County.
Orange City Mineral Spring, Orange City, Volusia County.
Panacea Mineral Spring, Wakulla County.
Suwannee Springs, Suwannee, Suwannee County.
White Sulphur Springs, White Springs, Hamilton County.

GEORGIA.

There was a slight falling off in the mineral-water trade in Georgia during the year, although 1 new spring—the Menlo—was added to the list of the previous year, the net loss of output being about 11 per cent and of value about 17 per cent. The decrease is due to the falling off of the output of the springs at a single locality. All of the water except a very small quantity is used for medicinal purposes. Resorts are located near 5 of the springs and have aggregate accommodations for over 700 people. The following 8 springs reported sales during the year:

Artesian Lithia Well, Austell, Cobb County.
Austell Lithium Spring, Austell, Cobb County.
Bowden Lithia Spring, Lithia Springs, Douglas County.
Catoosa Spring, Catoosa, Catoosa County.
Daniel Mineral Spring, Union Point, Greene County.
Hughes Mineral Spring, near Rome, Floyd County.
Lith-Aris Spring, Austell, Cobb County.
Menlo Spring, Menlo, Chattooga County.

IDAHO.

There is no material change in the conditions in Idaho. The 1 spring credited to the State reports increased sales in 1905.

Idanha Spring, Soda Springs, Bannock County.

ILLINOIS.

Leaving out of account certain springs included in the report for 1904, the waters of which were used almost entirely for city supplies, the mineral water output has shown an important increase in volume over 1904, although the number of springs has decreased, owing to two being abandoned and one turned into city supply.

Somewhat over one-fifth of the output is used for medicinal purposes, the remaining four-fifths being used as table water. Five of the springs are used as resorts, having accommodations for several hundred people. At 4 of them the water is used for bathing purposes. The 11 springs reporting sales are as follows:

Abana Spring, Libertyville, Lake County.
Aqua Vitæ Mineral Springs, near Maquon, Knox County.
Black Hawk Spring, Rock Island, Rock Island County.
Diamond Mineral Spring, near Grantfork, Madison County.
Gravel Spring, 5 miles northwest of Jacksonville, Morgan County.
Macinac Spring, near Carlock, Woodford County.
Mokena Mineral Spring, near Mokena Village, Will County.
Original Springs, Okawville, Washington County.
Perry Mineral Spring, northeast part of Pike County.
Sanicula Spring, Ottawa, Lasalle County.
White Diamond Spring, South Elgin, Kane County.

INDIANA.

The year 1905 was a very prosperous one in the mineral-water trade in Indiana. Five new springs, Attica Lithia, Blue Mountain Laxine, David Bronson, McCullough, and Mineral Spa, reported sales for the year, making a total of 23 productive springs for the year, which is 7 more than in 1904. The output was more than double that of the previous year, and the value also largely increased. The increased production is due both to the opening of new springs and to the larger output of the old. Nearly all the water is reported as used for medicinal purposes. Thirteen of the springs are the sites of resorts, which have aggregate accommodations for over 2,500 people; at 11 the waters are used for bathing. The 23 springs reporting sales are as follows:

Attica Lithia Spring, Attica, Fountain County.
Blue Cast Magnetic Spring, Woodburn, Allen County.
Blue Mountain Laxine, northeast part of Brown County.
Cartersburg Magnetic Spring, Cartersburg, Hendricks County.
Coats Spring, Logan Township, Pike County.
David Bronson Spring, Terre Haute, Vigo County.
Elliott Spring, Willow Valley, Martin County.
French Lick Springs. (See Pluto, Prosperine, and Bowles Springs.)
Greenwood Mineral Well, Greenwood, Johnson County.
Hunter Mineral Spring, Kramer, Warren County.
Kickapoo Magnetic Spring, Attica, Warren County.
King's Mineral Well, 14 miles north of New Albany, Clark County.
Lasalle Spring, Indian Springs, Martin County.
Laxine Spring, Mount Moriah Brown County.
Lodi Mineral Well, Silverwood, Fountain County.
McCullough Spring, Oakland City, Gibson County.
Mineral Spa Lithia Spring, Richmond, Wayne County.
Mudlavia Lithia Spring, Kramer, Warren County.
Mudlavia Sulphur Spring, Kramer, Warren County.
Paoli Lithia Spring, Paoli, Orange County.
Pluto, Prosperine, and Bowles springs, French Lick, Orange County.
Vancleave Springs, Crawfordsville, Montgomery County.
West Baden Springs, West Baden, Orange County.
White Sulphur Spring or Neptune Spa, Union Township, Crawford County.

INDIAN TERRITORY.

The one spring credited to Indian Territory reports sales for 1905. It is:

Beach Spring, Sulphur, Chickasaw Nation.

IOWA.

The mineral-water trade in Iowa was in a flourishing condition during the year; the output was nearly three times as great as in 1904, and twice as great as the largest output of any previous year, and the value of the waters was almost doubled. The increase was due largely to the growing demand for Iowa waters, the number of springs reporting being the same as in 1904. Practically all of the waters are applied to medicinal purposes. Two of the springs are used as resorts, with aggregate accommodations for several hundred people. At one of them the water is used for bathing purposes. The three following reported sales during the year:

Boone Mineral Well, Boone, Boone County.
Colfax Spring, Colfax, Jasper County.
Red Mineral Spring, Eddyville, Wapello County.

KANSAS.

The mineral-water trade in Kansas has shown a slight increase over 1904, although the number of springs reporting was one less, the increase being due mainly to the normal growth of trade. All but about one-tenth of the water is used for medicinal purposes. Nine of the springs are the sites of resorts, with accommodations for about 900 people; at 7 the water is used for bathing purposes. The 15 following springs reported sales:

AbilenA Spring, Abilene, Dickinson County.
Arrington Mineral Spring, Arrington, Atchison County.
Blasing Natural Medical Spring, Manhattan, Riley County.
Boon Mineral Spring, Topeka, Shawnee County.
California Spring, 4 miles north of Ottawa, Franklin County.
Geuda Spring, Geuda, Cowley County.
Hoover Mineral Spring, Onaga, Pottawatomie County.
Lithium Spring, Mankato, Jewell County.
Merrill Spring, Carbondale, Osage County.
Phillips Mineral Spring, Topeka, Shawnee County.
Sand Spring, near Abilene, Dickinson County.
Sun Mineral Spring, near Morrell, Brown County.
Sycamore Mineral Spring, northwest part of Brown County.
Waconda Spring, near Cawker City, Mitchell County.
Wetmore Mineral Spring, Wetmore, Nemaha County.

KENTUCKY.

The year 1905 was a prosperous one in the Kentucky mineral-water trade. The number of springs remained as in 1904, but the business increased rapidly during the year, the output showing a gain of 39 per cent and the value of over 30 per cent. Nearly three-fourths of the water is used for medicinal purposes, the remaining one-fourth being used as table water. Two of the springs are used as resorts, with accommodations for several hundred people; at both of them the water is said to be used for bathing purposes. The 5 commercial springs in Kentucky are as follows:

Anita Spring, Lagrange, Oldham County.
Blue Lick Springs, Blue Lick Springs, Nicholas County.
Hamby Salts, Iron, and Lithia Springs, Dawson Springs, Hopkins County.
Lexington Lithia Springs, Lexington, Fayette County.
White's Crab Orchard Salts Springs, Crab Orchard, Lincoln County.

LOUISIANA.

The mineral-water trade in Louisiana showed a marked increase during the year, due in part to the output of the additional spring reporting in 1905, and to the increase in production of the other. Much of the increase in output is probably to be attributed to the increased demand at New Orleans, owing to the large number of people who were prevented from leaving town during the hot months on account of the yellow fever. About one-fourth of the water is used for medicinal purposes, the remainder as table water. One of the springs is the site of a resort, and the waters are used for bathing purposes. The two springs reporting are as follows:

Abita Spring, Abita, St. Tammany Parish.
Ozone Spring, Pearl River Station, St. Tammany Parish.

MAINE.

In general the mineral water trade in Maine was fairly satisfactory during the year, a large number of the springs showing slight increases of production. Moreover the number of springs reporting sales is 6 more than in 1904. There was, however, a falling off of about 24 per cent in the production, due mainly to the decrease in volume of one or two large springs. The average price was also somewhat less than in the preceding year. Somewhat more than one-half of the water is used for medicinal purposes. Resorts having aggregate accommodations for several hundred people are located at 8 of the springs; at 4 of them the water is said to be used for bathing purposes. The 29 springs reporting sales are as follows:

Baker Puritan Spring, Old Orchard, York County.
Carrabasset Mineral Spring, Carrabasset, Franklin County.
Cold Bowling Spring, Steep Falls, Limington, York County.
Crystal Mineral Spring, Auburn, Androscoggin County.
Forest Spring, Litchfield, Kennebec County.
Glenrock Mineral Spring, Greene, Androscoggin County.
Glenwood Spring, St. Albans, Somerset County.
Indian Hermit Mineral Spring, Wells, York County.
Ishka Springs, West Hancock, Hancock County.
Katagudos Spring, Eastbrook, Hancock County.
Keystone Mineral Spring, East Poland, Androscoggin County.
Mount Hartford Cold Spring, Hartford, Oxford County.
Mount Zircon Spring, Milton Plantation, Oxford County.
Oak Grove Spring, Brewer, Penobscot County.
Oxford Spring Home, Oxford, Oxford County.
Paradise Spring, Brunswick, Cumberland County.
Pejepscot Spring, Auburn, Androscoggin County.
Pine Spring, Topsham, Sagadahoc County.
Poland Spring, Poland, Androscoggin County.
Pownal Spring, New Gloucester, Cumberland County.
Raymond Spring, North Raymond, Cumberland County.
Rocky Hill Spring, Fairfield, Somerset County.
Sabattus Mineral Spring, Wales, Androscoggin County.
Seal Rock Spring, Saco, York County.
Switzer Spring, Prospect, Waldo County.
Thorndike Mineral Spring, Thorndike, Waldo County.
Ticonic Spring, Winslow, Kennebec County.
Underwood Spring, Falmouth Foreside, Cumberland County.
Wawa Lithia Spring, Oqunquit, York County.

MARYLAND.

The mineral water trade showed a moderate growth during 1905, the production increasing about one-tenth. The average price of the water, however, was somewhat lower, so that the actual value was very nearly that of the preceding year. Two new springs, the Artoisinal and Kah-Goon-Wah, placed their waters on the market in 1905. About two-fifths of the water is used for medicinal purposes, the remainder as table water. Two of the springs are used as resorts, with accommodations for a considerable number of people. The 5 springs reporting sales are as follows:

Artoisinal Well, Baltimore, Baltimore County.
Carroll Spring, Forest Glen, Montgomery County.
Chattolanee Spring, Chattolanee, Baltimore County.
Kah-Goon-Wah Deep Well, Catonsville, Baltimore County.
Takoma Spring, Takoma Park, Montgomery County.

MASSACHUSETTS.

The mineral-water trade in Massachusetts showed a marked falling off, amounting to about 20 per cent in 1905, due mainly to the decreased use of table water resulting from the introduction of better and the improved condition of other public supplies.

One new spring, the Oak Grove, reports sales during the year. The total number reporting is 3 more than in 1904. About seven-eighths of the water is used for table purposes, the remainder as medicinal water. Only 5 of the 59 springs reporting are the sites of resorts, but they have aggregate accommodations for about 500 people. None of the waters are reported to be used for bathing purposes. The following 59 springs report sales:

Abbott Spring, Methuen, Essex County.
Arctic Polar Spring, Spencer, Worcester County.
Ballardvale Spring, Andover, Essex County.
Beaver Dam Spring, Scituate, Plymouth County.
Belmont Crystal Spring, Belmont, Middlesex County.
Belmont Hill Spring, Everett, Middlesex County.
Belmont Spring, Belmont, Middlesex County.
Bodwell Spring, Lawrence, Essex County.
Burnham Spring, Methuen, Essex County.
Chapman 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 Spring, Lowell, Middlesex County.
Everett Crystal Spring, Everett, Middlesex County.
Farrington 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.
Howland Spring, New Bedford, Bristol County.
Hygeia Spring, Springfield, Hampden County.
Katahdin Spring, Lexington, Middlesex County.
King Philip Spring, Mattapoisett, Plymouth County.
Lakoo Crystal Indian Spring, Lawrence, Essex County.
Leland Spring, Natick, Middlesex County.
Lexington Spring, Lexington, 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.
Mount Holyoke Lithia Spring, South Hadley, Hampshire County.
Mount Pleasant Spring, Lowell, Middlesex County.
Mount Washington Cold Spring, Chelsea, Suffolk County.
Myles Standish Spring, South Duxbury, Plymouth County.
Nashobah Spring, Westford, Middlesex County.
Nobscot Mountain Spring, Framingham, Middlesex County.
Norwood Spring, Norwood, Norfolk County.
Oak Grove Spring, Lawrence, Essex County.
Pearl Hill Mineral Spring, Fitchburg, Worcester County.
Pepperell Spring, Pepperell, Middlesex County.
Purity Spring, Spencer, Worcester County.
Ravenwood Spring, Gloucester, Essex County.
Robbin Spring, Arlington Heights, Middlesex County.
Sager Spring, Danvers, Essex County.
Sand Spring, Williamstown, Berkshire County.
Shawmut Spring, West Quincy, Norfolk County.
Silver Seal Spring, Woburn, Middlesex County.
Simpson Spring, South Easton, Bristol County.
Steavens Spring, Lawrence, Essex County.
Sunnyside Spring, Franklin, Norfolk County.
Swampscott Spring, Swampscott, Essex County.
Trapelo Spring, Belmont, Middlesex County.
Undine Crystal Spring, Brighton, Suffolk County.
Valpey Spring, Lawrence, Essex County.
Whitman Spring, Whitman, Plymouth County.
Wilbraham Mountain Spring, Wilbraham, Hampden County.

MICHIGAN.

The output of mineral waters in Michigan decreased about 21 per cent in 1905, but, owing to the increased price obtained, the value more than doubled. The falling off of reported output is due mainly to the omission from the list of 1905 of certain springs, the waters of which are used entirely for bathing purposes. One new spring, the Dearborn Mineral Spring, reported sales for the year, making the total number of producers for the year 17, or 2 less than in 1904. About one-seventh of the water is used for medicinal purposes, the remainder as table water. Six or more of the springs are used as resorts, having aggregate accommodations in their vicinity for several thousand people. The waters of 3 of these are said to be used for bathing purposes. The 17 springs reporting are as follows:

Andrews Magnetic Mineral Spring, St. Louis, Gratiot County.
Bromo-Hygeia Mineral Well, Coldwater, Branch County.
Cooper Farm Spring, Birmingham, Oakland County.
Dearborn Mineral Spring, Dearborn, Wayne County.
Eastman Spring, Benton Harbor, Berrien County.
Midland Mineral Spring, Midland City, Midland County.
Mount Clemens Sprudel Spring, Mount Clemens, Macomb County.
No-che-mo Mineral Spring, Reed City, Osceola County.
Pagoda Spring, Mount Clemens, Macomb County.
Plymouth Rock Mineral Well, Plymouth, Wayne County.
Ponce De Leon Spring, near Grand Rapids, Kent County.
Prosit Flowing Well, Flint, Genesee County.
Salutaris Spring, St. Clair, St. Clair County.
Sanitas Spring, Topinabee, Cheboygan County.
Sterling Mineral Spring, Crystal Falls, Iron County.
Victory Spring, Mount Clemens, Macomb County.
Yo-Landa Red Cross Spring (formerly Clark's Red Cross Spring), Big Rapids, Mecosta County.

MINNESOTA.

The mineral-water trade in Minnesota was very flourishing in 1905, this State showing the largest increase of any in the country. The gain is due largely to the increased use of spring water for table purposes, especially at Minneapolis, where the pollution of the public supply made the demand for pure water for drinking purposes imperative. The number of springs reporting is 6, or 2 more than in 1904. Practically all of the water is used for table purposes. None of the springs are used as resorts, but at one of them the water is said to be used for bathing purposes. The following 6 springs reported sales:

Glenwood and Inglewood Springs, Minneapolis, Hennepin County.
Highland Spring, St. Paul, Ramsey County.
Indian Medical Spring, Elk River, Sherburne County.
Mankato Mineral Spring, near Eagle Lake, Blue Earth County.
Owatonna Vichy Spring, Owatonna, Steele County.
Trio Siloam Spring, Austin, Mower County.

MISSISSIPPI.

The trade conditions in Mississippi were very satisfactory in 1905 considering the limitations placed upon the business by the quarantine resulting from the yellow-fever outbreak. Notwithstanding that the shipment of water was seriously interferred with, there was only a slight decrease in output during the year, the loss being practically counterbalanced by increased local consumption. One new spring, the Mammoth, reports sales. Somewhat more than two-fifths of the water was used for medicinal purposes, the remainder as table water. Resorts, with aggregate accommodations for several hundred people, are located near 6 of the springs, at 2 of which the waters are also utilized for bathing purposes. The 9 springs reporting, 3 more than in 1904, are as follows:

Arundel Lithia Spring, near Meridian, Lauderdale County.
Browns Wells, Browns Wells, Copiah County.
Castalian Spring, near Durant, Holmes County.
Godbold Mineral Well, Summit, Pike County.
Lowe Mineral Wells, Hazlehurst, Copiah County.
Mammoth Spring, Mammoth Springs, Percy County.
Robinson Mineral Spring, near Pocahontas, Madison County.
Stafford Mineral Spring, Stafford, Jasper County.
Tallaha Springs, Charleston, Tallahatchie County.

MISSOURI.

In Missouri the mineral-water trade showed a healthy growth during 1905, the output increasing more than a third over that of the preceding year and the value increasing about 45 per cent. Approximately three-eighths of the water is used for medicinal purposes, the remainder as table water. At least nine of the springs are the sites of resorts, with aggregate accommodations for over 1,000 people. The water is said to be used for bathing purposes at 6 springs. The following 15 springs report sales:

B. B. Springs, Bowling Green, Pike County.
Belcher Artesian Well, St. Louis, St. Louis County.
Blue Lick Spring, Blue Lick, Saline County.
Chalybeate Spring, Mooresville, Livingston County.
Crystal Lithium Spring, Excelsior Springs, Clay County.
Cusenbury Spring, 6 miles northeast of Kansas City, Jackson County.
El Dorado Spring, Eldorado Springs, Cedar County.
Haymaker Spring, Mercer County, near Lineville, Iowa.
Ion-i-an Lithia Spring, Bowling Green, Pike County.
Jackson Lithia Spring, Mount Washington, Jackson County.
Kal-I-Nat Bitter Spring, Bowling Green, Pike County.
Lineville Mineral Spring, Mercer County, near Lineville, Iowa.
McAllister Springs, McAllister, Saline County.
Sulpho-Saline, Regent, Siloam, and Soterian Springs, Excelsior Springs, Clay County.
Sweet Spring, Sweet Springs , Saline County.

MONTANA.

Of the two springs credited to Montana one reports sales for 1905. About half the water is used for medicinal purposes, the remainder as table water.

Lissner Mineral Springs, Helena, Lewis and Clark County.

NEBRASKA.

Sales are reported from the one spring of the State during 1905.

Victoria Mineral Spring, New Helena, Custer County.

NEVADA.

The single commercial spring credited to Nevada has been temporarily abandoned, owing to the destruction of its works by fire.

NEW HAMPSHIRE.

The mineral-water trade in New Hampshire was characterized by a material growth during the year, the output increasing nearly 13 per cent, and the value increasing about 8 per cent. About seven-eighths of the water is used as medicinal, the remainder as table water. A few of the springs are used as resorts, but at only one of them is the water used for bathing purposes. The 5 springs reporting sales are as follows:

Amherst Mineral Spring, Amherst, Hillsboro County.
Granite State Spring, Plaistow, Rockingham County.
Lafayette Mineral Spring, West Derry, Rockingham County.
Londonderry Lithia Spring, Londonderry, Rockingham County.
Pack Monadnock Lithia Spring, Temple, Hillsboro County.

NEW JERSEY.

The mineral-water trade in New Jersey was characterized by considerable activity, the output doubling during the year, while the value increased about 80 per cent, the gain being mainly in table water, which was extensively used in the cities. About six-sevenths of the water is used for table purposes, the remainder as medicinal water. One new spring, the Oakland, reports sales for the year. None of the springs are reported to be used for resorts or for bathing purposes. The 10 springs reporting are as follows:

Alpha Spring, Springfield, Union County.
Beacon Mountain Spring, Denville, Morris County.
Beech Spring, near Woodbury, Gloucester County.
Hatawanna Spring, Budd Lake, Morris County.
Kalium Spring, Collingswood, Camden County.
Kanouse Oakland Spring, Oakland, Bergen County.
Oakland Vernam Spring, Oakland, Bergen County.
Red Rock Spring, Spring Valley Road, Bergen County.
Trinity Springs, Borough of Ridgefield, Bergen County.
Watchung Spring, North Plainfield Township, Somerset County.

NEW MEXICO.

The mineral water trade was very flourishing in this Territory during the year, the number of springs reporting in 1905 being 6 as against 1 in 1904. The number of gallons sold shows a similar increase, as does also the value. Four of the springs are reported to be used as local resorts, with aggregate accommodations for 100 people. At 1 of them the water is used for bathing purposes. The 6 springs are as follows:

Artesian Coyote Well, 13 miles east of Albuquerque, Bernalillo County.
Coyote Canyon Mineral Spring, Coyote Canyon, Bernalillo County.
Faywood Hot Spring, Faywood, Grant County.
Harsch Iron Spring, Coyote Canyon, Bernalillo County.
Macbeth Spring, Las Vegas, San Miguel County.
Ojo Caliente Spring, Ojo Caliente, Taos County.

NEW YORK.

There was a considerable decrease in the volume of mineral water trade in 1905, due mainly to the falling off in the output reported from a number of the large springs at Saratoga and elsewhere. Four new springs, the Crystal, Emperor, Hagens Magnetic, and Pleasant Valley, reported sales for the year, while 10 have been abandoned or converted to other uses. Many of the smaller springs report increased outputs. Nearly one-fourth of the water is used for medicinal purposes, the remainder as table water. A considerable number of the springs are located at or near resorts, which have in the aggregate accommodations for several thousand people. At only a few of them are the waters used for bathing purposes. The 40 springs reporting are as follows:

Artesian Mineral Spring, Franklin Springs, Oneida County.
Avon Sulphur Springs, Avon, Livingston County.
Ayers Amherst Mineral Spring, Williamsville, Erie County.
Baldwin Cayuga Spring, Cayuga, Cayuga County.
Breesport Oxygenated Mineral Spring, Breesport, Chemung County.
Chautauqua Spring, Westfield, Chautauqua County.
Chemung Spring, Chemung, Chemung County

Crystal Springs, near Oswego, Oswego County.
Deep Rock Spring, Oswego, Oswego County.
Elixir Spring, Clintondale, Ulster County.
Geneva Mineral Water Spring, Geneva, Ontario County.
Glacier Spring, Franklin Springs, Oneida County.
Great Bear Spring, near Fulton, Oswego County.
Hagen's Magnetic Flint Rock Spring, Elmira, Chemung County.
Hide Franklin Spring, Ballston Spa, Saratoga County.
Kirkland Spring, Franklin Springs, 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.
Pleasant Valley Mineral Spring, Rheims, Steuben County.
Red Jacket Mineral Spring, Seneca Falls, Seneca County.
Saratoga County Artesian Lithia Spring, Ballston Spa, Saratoga County.
Saratoga Springs, Saratoga County:
- Champion Spring.
- Chief Spring.
- Congress Spring.
- Emperor Spring.
- Geyser Spring.
- Hathorn Spring.
- High Rock Spring.
- Lincoln Spring.
- Patterson Mineral Spring.
- Royal Spring.
- Saratoga Carlsbad Spring.
- Saratoga Seltzer Spring.
- Saratoga Victoria Spring.
- Star Spring.

Split Rock Spring, Franklin Springs, Oneida County.
Vita Spring, Fort Edward, Washington County.
Washington Lithia Spring, Ballston Spa, Saratoga County.

NORTH CAROLINA.

There was a general improvement in the mineral-water trade in this State in 1905, the output increasing about one-fourth, while the value increased about one-third. The number of springs reporting was 3 more than in 1904, 2 of them, the Buckhorn Lithia and the Red Springs, being reported for the first time. Most of the water is used for medicinal purposes. Resorts are located at 7 of the springs and have accommodations for about 1,000 people. At one of them the water is used for bathing purposes. The following 10 springs reported sales in 1905:

Alkalithia Spring, Alkalithia Springs, Alexander County.
Barium Rock Spring, Barium Springs, Iredell County.
Buckhorn Lithia Spring, Bullock, Granville County.
Jackson Spring, Jackson, Moore County.
Mida Spring, near Charlotte, Mecklenburg County.
Panacea Spring, near Littleton, Warren County.
Red Spring, Red Springs, Robeson County.
Seven Springs, near Goldsboro, Wayne County.
Thompson Bromine Arsenic Spring, Crumpler, Ashe County.
Vade Mecum Spring, Vade Mecum, Stokes County.

NORTH DAKOTA.

The one spring credited to North Dakota reported sales for 1905:

Hydatso Spring, Tower City, Cass County.

OHIO.

The mineral-water trade in Ohio remained about the same as in 1904. Two new springs, the Bellmore Mineral and the Quakerdale, report sales, while 3 were taken from the list, owing to their being abandoned or to the conversion of the water to other purposes. The output shows a considerable decrease from that of 1904, due mainly to the falling off in production caused by the omission of certain springs the output of which were put to other than mineral-water purposes. The value of the waters actually used for medicinal and table purposes shows a slight increase over that of 1904. Four of the springs are reported to be used as resorts, with aggregate accommodations for several hundred people. The water at 3 of them is said to be used for bathing purposes. The 23 springs reporting are as follows:

Alba Spring, Rockport, Cuyahoga County.
Bellmore Mineral Spring, Fairfield, Columbiana County.
Buckeye Lithia Spring, Martins Ferry, Belmont County.
Crum Mineral Spring, Austintown, Mahoning County.
Deerfield Spring, Deerfield, Portage County.
Fargo Spring, Ashtabula, Ashtabula County.
Fisher's Magnesia Mineral Spring, Clinton Township, Franklin County.
Greenspring Artesian Well, Greenspring, Sandusky County.
Kinsely Springs, North Robinson, Crawford County.
Mineral Spring, Mineral Springs, Adams County.
Oak Ridge Mineral Spring, Greenspring, Sandusky County.
Odevene Spring, Delaware, Delaware County.
Painesville Mineral Spring, Painesville, Lake County.
Puritas Spring, Rockport, Cuyahoga County.
Purtlebaugh Spring, Urbana, Champaign County.
Quakerdale Spring, Belmont County.
Rex Mineral Spring, New Richmond, Clermont County
Ripley Bromo-Lithia Spring, Ripley, Brown County.
Sand Rock Spring, Canton, Stark County.
Sulphur Lick Spring, near Chillicothe, Ross County.
Tallewanda Spring, College Corner, Preble County.
Wheeler Spring, Youngstown, Mahoning County.
Wood Lithia Spring, near Bridgeport, Belmont County.

OKLAHOMA.

One of the 2 springs formerly credited to Oklahoma has been abandoned, but the remaining spring reports sales for 1905.

Lewis Crystalline Lithia Well, Oklahoma City, Oklahoma County.

OREGON.

The mineral water trade in Oregon shows a marked falling off from that of 1904, the loss, amounting to nearly one-half, being due to the omission of a single spring reporting in 1904. One new spring, the McBean Soda, reported sales for the year. The production in 1905, however, was nearly as large as in the years previous to 1904. Practically all of the water is used for medicinal purposes. Six of the springs are the sites of resorts, which can accommodate several hundred people. At 2 of them the water is used for bathing purposes. The following 9 springs report sales:

Boswell Mineral Spring, Boswell, Douglas County.
Cascade Mineral Spring, Cascadia, Linn County.
Colestin Spring, Colestin, Jackson County.
Lake View Hot Spring, Lake View, Lake County.
McBean Soda Spring, Soda Valley, Grant County.
Oregon West Baden Spring, Boswell, Douglas County.
Siskiyou Spring, Soda Springs, Jackson County.
Slate Mineral Spring, Sodaville, Linn County.
Wolfer's Mineral Spring, Hubbard, Marion County.

PENNSYLVANIA.

The condition of the mineral water trade in Pennsylvania was very satisfactory in 1905, the output increasing nearly one-half, while the value more than doubled, the increase being due to the 6 additional springs reporting this year and to the general growth of the mineral water trade. About three-fifths of the output is used for medicinal purposes, the remainder as table water. Resorts are located at or near 10 of the springs and have accommodations for nearly 2,000 people. At 4 of the springs the water is reported to be used for bathing purposes. The 27 springs reporting are as follows:

Bedford Chalybeate Spring, near Bedford, Bedford County.
Bedford Mineral Spring, Bedford, Bedford County.
Black Barren Mineral Spring, Pleasant Grove, Lancaster County.
Buena Vista Springs, Buena Vista, Franklin County.
Calvin White Sulphur Springs, Sulphur Springs, Bedford County.
Corry Artesian Spring, Corry, Erie County.
De Vita Mineral Springs, Cambridge Springs, Crawford County.
East Mountain Lithia Well, Factoryville, Wyoming County.
Glen Summit Spring, Glen Summit Springs, Luzerne County.
Granny Coon Spring, North Point, Indiana County.
Gray Mineral Spring, Cambridge Springs, Crawford County.
Harrison Valley Mineral Spring, Harrison Valley, Potter County.
Imperial Spring, Angelica, Berks County.
Lang Mineral Well, Venangotown, Crawford County.
Magnesia Spring, Cambridge Springs, Crawford County.
Pavilion Spring, South Mountain, Berks County.
Petticord Spring, Cambridge Springs, Crawford County.
Pocono Mineral Spring, Bucks Township, Wilkes-Barre, Luzerne County.
Ponce de Leon Spring, near Meadville, Crawford County.
Pulaski Natural Mineral Spring, Pulaski, Lawrence County.
Rennysons Tredyffin Spring, Berwyn, Chester County.
Ross-Common Spring, Ross-Common, Monroe County.
Saegertown Mineral Springs, Saegertown, Crawford County.
Sizerville Mineral Spring, Sizerville, Cameron County.
Tuckahoe Mineral Spring, Northumberland, Northumberland County.
Whann Lithia Spring, Franklin, Venango County.
White House Spring, Neversink Mountain, Berks County.

RHODE ISLAND.

The mineral-water trade in Rhode Island changed but little in 1905. The number of springs reporting is the same. There was a slight increase in the number of gallons sold; but, owing to a falling off in the price, there was a decrease of one-third in value. None of the springs are the sites of resorts, nor is the water of any of them used for bathing purposes. The four springs are as follows:

Berry Spring, Providence, Providence County.
Gladstone Spring, Narragansett Pier, Washington County.
Holly Mineral Spring, East Woonsocket, Providence County.
Ochee Mineral and Medicinal Spring, Johnston, Providence County.

SOUTH CAROLINA.

The mineral-water business was nearly stationary in this State during the year. The number of springs is 2 more than in 1904 and the output is slightly greater, but, owing to a decrease in price per gallon, there has been a slight falling off of the value of the product. Four of the springs are the sites of resorts with aggregate accommodations for several hundred people. The water is used for bathing purposes at one of them. The 7 springs reporting sales are as follows:

Buffalo Lick Springs, near Carlisle, Union County.
Cherokee Spring, Spartanburg, Spartanburg County.
Glowing Spring, Dresden, Abbeville County.
Harris Lithia Springs, Harris Springs, Laurens County.
Rives Mineral Spring, near Lancaster, Lancaster County.
Wert Spring, Wert Springs, Union County.
White Diamond Lithia Spring, near Kings Creek, York County.

SOUTH DAKOTA.

The following spring, 1 of the 2 credited to South Dakota, reports sales for 1905:

Minnehaha Springs, Sioux Falls, Minnehaha County.

TENNESSEE.

The growth of the mineral-water trade in this State has been phenomenal and increased fourfold in quantity during the year 1905. Two new springs, Deep Cave Lithia Well and Pylant Spring, report sales for the first time, while many of the others show increased production. The increase seems to have resulted from the more active exploitation of the larger springs as well as to the increased production of the smaller. Resorts are situated near eleven of the springs, and accommodate over 1,500 people. None of the waters are reported as being used for bathing purposes. The 14 springs are as follows:

Deep Cave Lithia Well, near Nashville, Davidson County
Eastbrook Spring, Eastbrook, Franklin County.
Hinson Springs, near Lexington, Henderson County.
Horn Springs, Horn Springs, Wilson County.
Idaho Spring, near Clarksville, Montgomery County.
Montvale Spring, Montvale, Blount County.
Pylant Springs, Franklin County.
Red Boiling Spring, Red Boiling Springs, Macon County.
Rhea Springs, Rhea Springs, Rhea County.
Richardsons Lockeland Spring, near Nashville, Davidson County.
Tate Epsom Spring, Tate Springs, Grainger County.
Whittle Springs, near Knoxville, Knox County.
Willow Brook Spring, Craggie Hope, Cheatham County.
Wrights Epsom Lithia Spring, Mooresburg, Hawkins County.

TEXAS.

The mineral-water trade of Texas showed a satisfactory growth during the season of 1905, the output increasing over 33 per cent and the value more than doubling. Three new springs, the Artesia, Pike, and White Sulphur Wells, report sales, but 2 others have been abandoned. The total number reporting, however, is 14 more than last year. The increased production is due mainly to a general growth of the demand for the Texas waters for medicinal purposes, about six-sevenths of the total output being used for this purpose. There are said to be resorts in the vicinity of 18 of the springs, the aggregate accommodations being sufficient for several thousand people. Four of the waters are used for bathing purposes. The 28 springs reporting sales are as follows:

Artesia Bottling Company Well, Fort Worth, Tarrant County.
Capp Wells, Longview, Gregg County.
Dalby Spring, Dalby Springs, Bowie County.
Dulling Mineral Wells, near San Antonio, Bexar County.
Farrier Spring, Dalby Springs, Bowie County.
Georgetown Mineral Wells, Georgetown, Williamson County.
High Island Mineral Spring, High Island, Galveston County.
Hynson Spring, Harrison County.
Lone Star Mineral Spring, near Texarkana, Brown County.
Loretto Mineral Wells, Elkhart, Anderson County.
Marlin Hot Wells, Marlin, Falls County.
Milford Mineral Well, Milford, Ellis County.
Mineral Wells, Palo Pinto County:
    Congress Well.
    Crazy Well.
    George P. Barber Well.
    Gibson Well.
    Palo Pinto Wells.
    Pike Well.
    Sangcura Spring.
    Specific Well.
    Texas Carlsbad Well.
    White Sulphur Well.
Overall Mineral Well, Franklin, Robertson County.

Peterman Red Spring, Mount Pleasant, Titus County.
Rosborough Spring, 9 miles south of Marshall, Harrison County.
Texarkana Spring, near Texarkana, Bowie County.
Tioga Mineral Wells, Tioga, Grayson County.
Wootan Wells, Wootan Wells, Robertson County.

UTAH.

Utah loses 1 spring, leaving only 2, of which neither report sales for 1905.

VERMONT.

The mineral-water trade in Vermont showed a healthy growth during 1905, the output increasing about 15 per cent. The value also increased. About one-fifth of the water is used for medicinal purposes, the remainder as table water. Resorts are located at 4 of the springs, and at 2 of them the water is used for bathing. Accommodations for nearly 1,000 people are available. All of the 6 springs in the State report sales.

Alburg Lithia and Sulphur Springs, Alburg Springs, Grand Isle County.
Brunswick White Sulphur Spring, Brunswick, Essex County.
Clarendon Spring, Clarendon Spring, Rutland County.
Equinox Spring, Manchester, Bennington County.
Missisquoi Spring, Sheldon, Franklin County.
Vermont Mineral Spring, Putney, Windham County.

VIRGINIA.

There was a decided increase in the mineral-water trade of Virginia in 1905 over the previous year; the output increased considerably, and the value, owing to the increased price per gallon, nearly doubled. The difference is probably to be attributed to the natural development of the business. Nearly four-fifths of the water is used for medicinal purposes. Nineteen of the springs are reported to be used as resorts, having accommodations for several thousand people. At 5 of them the water is used for bathing purposes. The 37 springs reporting, which are 2 more than last year, are as follows:

Aetna Lithia Spring, Roanoke, Roanoke County.
Alleghany Spring, Alleghany Springs, Montgomery County.
Augusta White Lithia Spring, near Augusta Springs, Augusta County.
Basic Lithia Spring, Basic City, Augusta County.
Bear Lithia Spring, near Elkton, Rockingham County.
Beaufont Lithia Spring, near Manchester, Chesterfield County.
Bellfont Lithia Spring, Manchester, Chesterfield County.
Berry Hill Mineral Spring, near Elkwood, Culpeper County.
Blue Ridge Dyspepsia Spring, Blue Ridge Springs, Botetourt County.
Buffalo Lithia Springs, Buffalo Lithia Springs, Mecklenburg County.
Chloride Calcium and Lithia Springs, Chase City, Mecklenburg County.
Como Lithia Spring, East Richmond, Henrico County.
Crockett Arsenic Lithia Spring, Crockett Springs, Montgomery County
Diamond Spring, 5 miles east of Norfolk, Princess Anne County.
Farmville Lithia Spring No. 2, Farmville, Cumberland County.
Fonticello Spring, near Richmond, Chesterfield County.
Golindo Lithia Spring, Augusta County.
Healing Springs, Healing Springs, Bath County.
Hume Spring, Bancroft, Alexandria County.
Hunter Pulaski Alum Spring, Walkers Valley, Pulaski County.
Jeffress Lithia Silica Spring, Jeffress, Mecklenburg County.
Kayser Lithia Spring, Staunton, Augusta County.
Lone Jack Spring, Lone Jack Station, Campbell County.
Magee Chlorinated Lithia Spring, Clarksville, Mecklenburg County.
Massanetta Spring, Massanetta Springs, Rockingham County.
Nye Lithia Springs, Wytheville, Wythe County.
O'Connell Lithia Spring, near Stribling Springs, Augusta County.
Otterburn Lithia Spring, Amelia, Amelia County.

Paeonian Springs, Paeonian Springs, Loudoun County.
Powhatan Spring, near Falls Church, Alexandria County.
Rockbridge Alum Springs, Rockbridge Alum Springs, Rockbridge County.
Seawright Magnesia Lithia Spring, Staunton, Augusta County.
Stribling Springs (alum, blue sulphur, and chalybeate), near Staunton, Augusta County.
Virginia Lithia Spring, Swineford station, Chesterfield County.
Virginia Magnesia Alkaline Spring, near Staunton, Augusta County.
Wallawhatoola Alum Spring, near Millboro Springs, Bath County.
Wyrick Spring, Crockett, Wythe County.

WASHINGTON.

In Washington the mineral-water trade remained nearly stationary in 1905. All of the springs in the State report sales, and there was a satisfactory increase in the output. Owing to the lower price per gallon, however, the value of the product decreased slightly. Nearly one-half of the water is used for medicinal purposes, the remainder as table water. Two of the springs are reported to be used as resorts, with aggregate accommodations for over 500 people. At both the water is used for bathing purposes. The 4 springs are as follows:

Medical Lake Mineral Water, Medical Lake, Spokane County.
Moffett Hot Springs, Cascades, Skamania County.
Olympia Hygeian Spring, Tumwater, Thurston County.
Soda Springs, Ahtanum Mountains, Yakima County.

WEST VIRGINIA.

There was a very decided increase in the mineral-water trade in West Virginia during 1905, the output being nearly double that of 1904 and greater than that of any previous year except 1903. The value was over three times that of 1904, and much greater than in any previous year. So far as known the increase is to be attributed to the increased demand for West Virginia medicinal waters, nearly all of the output being used for this purpose. Resorts are located at 4 of the springs, and are said to have accommodations for several thousand people. At 2 of them the water is used for bathing purposes. The following 6 springs report sales:

Borland Mineral Well, Borland, Wood County.
Greenbrier Alum Spring, 5 miles east of Lewisburg, Greenbrier County.
Greenbrier White Sulphur Springs, White Sulphur, Greenbrier County.
Manacea Irondale Spring, near Independence, Preston County.
Pence Spring, Pence Springs, Summers County.
Webster Salt Sulphur Springs, Webster Springs, Webster County.

WISCONSIN.

The mineral-water business in Wisconsin was characterized in 1905 by a material increase in output, due largely to the greater use of table waters. The relative proportion of such low-priced waters, however, led to a decrease in the value of the product, which is considerably less than in 1904. About one-fifth of the water is used for medicinal purposes, the remainder as table water. Resorts are located at or near 6 of the springs and furnish accommodations for over 1,000 people. The water at two of them is said to be used for bathing purposes. The 27 springs reporting sales are as follows:

Allouez Magnesia Spring, Green Bay, Brown County.
Alta Springs, Dunfield, Lincoln County.
Bay City Spring, Ashland, Ashland County.
Bethania Spring, Osceola, Polk County.
Darlington Mineral Spring, Darlington, Lafayette County.
Fort Crawford Spring, Prairie du Chien, Crawford County.
Lebenwasser Mineral Spring, Green Bay, Brown County.
Nee-Ska-Ra Mineral Spring, Wauwatosa, Milwaukee County.
St. Johns Spring, Green Bay, Brown County.

Salvator Mineral Spring, Green Bay, Brown County.
Sanitas Fountain, Stony Beach, Winnebago County.
Sheboygan Mineral Spring, Sheboygan, Sheboygan County.
Silver Sand Spring, Milwaukee, Milwaukee County.
Solon Springs, Solon Springs, Douglas County.
Sulphur Mineral Spring, Oshkosh, Winnebago County.
Waukesha Springs, Waukesha County.
- Almanaris Spring.
- Anderson's Waukesha Spring.
- Arcadian Spring.
- Bethesda Spring.
- Glen Rock Mineral Spring.
- Minniska Spring.
- Silurian Mineral Spring.
- Silvan Spring.
- Sotarian Spring.
- Waukesha Imperial Spring.
- White Rock Mineral Spring.

Wautoma Rainbow Mineral Spring, Wautoma, Waukesha County.

WYOMING.

One of the 2 springs credited to Wyoming reports sales during 1905.

Saratoga Hot Springs, Saratoga, Carbon County.

IMPORTS.

The following tables show the quantity and value of mineral water imported into this country during the last six years:

Mineral waters imported and entered for consumption in the United States, 1900–1905.

Year.	Natural waters.		Year.	Natural waters.	
	Quantity.	Value.		Quantity.	Value.
	Gallons.			*Gallons.*	
1900	[a]2,485,042	[a]$687,874	1903	[a]2,851,964	[a]$846,294
1901	[a]2,567,323	[a]744,392	1904	[a]2,901,828	[a]868,262
1902	[a]2,461,830	[a]712,827	1905	[a]3,150,030	[a]926,357

[a] Including artificial.

According to the Treasury Department, no shipments of water have been made from the United States since the export of a few hundred gallons in 1883.

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By A. C. Peale.

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PRODUCTION OF MONAZITE, ZIRCON, GADOLINITE, AND COLUMBITE OR TANTALUM MINERALS.

By Joseph Hyde Pratt.

INTRODUCTION.

During the last five years there has been a considerable advance made in the manufacture of various forms of apparatus for lighting purposes. These investigations and inventions have led to the practical introduction of certain metals and metallic oxides into the arts which before this time had little or no commercial value. With the demand for these metals and metallic oxides there at once arose the question of their sources of supply, which has resulted in the mining of a number of minerals that were formerly supposed to be exteremely rare in their occurrence, but which have now been found in considerable quantity. Experiments are being carried on with still other metals in regard to their usefulness for the manufacture of various incandescent and electric lamps.

The metals and the metallic oxides that are now being used and experimented with are tantalum, cadmium, zirconia, thoria, yttria, and cerium, lanthanum, and didymium oxides. With the exception of cadmium, all these materials are being used commercially in the manufacture of different lamps and are obtained from the following minerals: Monazite, zircon, gadolinite, columbite, and tantalite. These minerals and their occurrences have been described in detail in the reports of this Bureau for 1903 and 1904. The use of cadmium for lighting purposes is still in the experimental stage, and, although cadmium lamps have been made, they are still principally of scientific interest. As far as is known, no cadmium lamp has been made that would have a practical commercial value.

MONAZITE.

The demand for the mineral monazite, which contains the oxides used in the manufacture of mantles for the Welsbach and other incandescent gaslights, is constantly increasing, and many inquiries have been received during the past year for information regarding the source of supply of this mineral, not only for domestic but also for foreign consumption. Although monazite has been found sparingly at many localities throughout the United States, the Carolinas are still the only States that are producing this mineral commercially. During 1905, however, a probable new source of supply of this mineral has been worked out by the investigations that have been carried on at the concentrating plant of the United States Geological Survey at Portland, Oreg., which has been testing systematically the black sands of the Pacific slope as to their mineralogical contents. The results of this investigation have shown the presence of some monazite and more zircon in many of these sands, especially in those from Oregon and Idaho. By using the Wetherill magnetic separator an almost perfect separation can be made of both the zircon and the monazite. The results of this investigation of the black sands will be published in detail as a bulletin of the United States Geological Survey and will give the various localities where monazite has been found in the sands and its percentage.

In the Carolinas the monazite districts have been pretty thoroughly bounded, but occasionally a new section is discovered showing a sufficient quantity of monazite to make mining profitable, and thus extending the boundary slightly. In Greenville County, S. C., in the vicinity of Lenneman, in Grove Township, considerable monazite has been found in the creeks and branches, and during the past year some of this material has been shipped.

An interesting occurrence of monazite has been found in Queensland.[a] It has been known for some time that monazite occurs sparingly in the beach sands on the coast of Queensland, and that probably the most promising deposits are near the mouths of the Tweed and the Johnstone rivers. These deposits have not as yet been proved to contain this mineral in commercial quantities. The finding, however, of the monazite in these sands has led to further search which resulted in locating monazite in the original rock in two localities, namely, the Walsh and the Tinaroo mineral fields. Regarding these Mr. Dunstan says:

> The monazite was observed to occur in pure crystalline masses, sometimes several pounds in weight, and also in small cleavable grains. Both forms are irregularly disseminated in quartz, black mica (biotite), and chloritic mica, and are in association with wolframite, molybdenite, scheelite, tinstone, and mispickel. With the exception of wolframite, these associated minerals are only in comparatively small quantities. The deposits containing the monazite are in granite country, but close to quartz porphyry and slate. In the granite, and also at the junction of this rock with the porphyry and slate, irregular masses of greisen have been formed from the alteration of the granite, and it is in this, following closely the behavior of the wolframite, that the monazite deposits are to be found.

It is not improbable that the monazite in these deposits may become of commercial value, especially as it could be obtained as a by-product in mining the wolframite ore.

An interesting mineral, thorianite, was discovered early in 1905, associated with corundum, zircon, tin, topaz, spinel, etc. The mineral was first found by Mr. W. D. Holland in the refuse from gem washing near Balangoda, Ceylon, and was supposed to be uraninite or pitchblende, but upon analysis it was found to contain a very large percentage of thoria. The analysis of the mineral is as follows: [b]

Analysis of thorianite.

Thorium oxide	76.22
Cerium, lanthanum, and didymium oxides	8.04
Zirconium oxide	Trace.
Uranium oxide	12.33
Ferric oxide	.35
Lead oxide	2.87
Silica	.12
	99.93

The specific gravity of the mineral is given as 9.32, and it was observed in black, cubical crystals, which are fairly hard and give a brown streak. According to Mr. W. F. Petterd,[c] the powdered thorianite dissolves readily in dilute sulphuric as well as in nitric acid. It has also been shown to be highly radioactive because of its uranium contents.

[a] Dunstan, B., Acting Government Geologist, Mining World, August 26, 1905.

[b] Dunstan, Wyndham R., Ceylon Mineral Survey No. III: Mining Engineering (London), March, 1905, and Min. Mag., May, 1905.

[c] Min. World, Sept. 16, 1905.

It is not improbable that this new mineral may be found in certain localities of the United States where tin, topaz, zircon, and monazite are found. According to the reports on this mineral, it is one that could be more easily utilized as a source of thoria than monazite, and as it has a much higher percentage of this compound, it would be much more valuable.

In view of the large increase in the production of monazite in 1905 as compared with that of 1904, of the new companies organized that require thoria in their manufactured products, and of the inquiries that have been received from abroad, any deposit that contains monazite or any other thoria mineral in apparent quantity is worthy of careful investigation.

ZIRCON AND GADOLINITE.

The occurrence of these two minerals was described in detail in the reports for 1903 and 1904. The quantities of zircon and gadolinite used in the arts are very small, and during 1904 there was a sufficient production to satisfy the demand for these minerals during the past year, so that there was no production whatever of gadolinite during 1905. There was a small production of zircon, which, however, was not marketed.

TANTALUM MINERALS.

The tantalum minerals are in demand on account of their containing the metal tantalum, which is used at the present time only in the manufacture of very fine wire for use in the construction of what is known as the tantalum lamp. Both the occurrences of the tantalum minerals and the tantalum lamp were described in detail in the report for 1904, and much has been written regarding the lamp in various scientific and commercial magazines during 1905, indicating its successful commercial use. In a recent paper read at the electrical convention in Denver and published in part in the American Inventor,[a] Dr. Louis Bell makes the following statements regarding the value of this lamp:

> The mean result of various tests of lamps were: From clear globes, 22.2 candlepower at 1.85 watts per candlepower, and from frosted globes, 19.08 candlepower at 2.1 watts per candle. It is interesting to note that the clear lamp gives just about one candlepower per inch of incandescent filament, which implies an intrinsic brilliancy of somewhere about 500 candlepower per square inch of filament—a figure much higher than in the ordinary incandescent. As illuminants the lamps are certainly very excellent, but their introduction raises some most interesting questions for the central station operator. Putting aside all the petty questions that will be raised about the new lamp for commercial reasons, the broad fact remains that we are here dealing with a bona fide 2-watt lamp having a life fairly comparable with the carbon filament lamps now customarily in use. Moreover, it is a competitor of these, socket by socket, and not as a substitute, with particular requirements, as in the case of the Nernst lamp, or the very small arcs. There is some doubt as to the life of the tantalum lamp when exposed to unusual vibration, which may perhaps bar it in some special locations, but for the every-day work of the central station there is good reason to believe it generally applicable.
>
> Its price can hardly be said to be fixed in this country, but abroad, in Berlin, it is about $1 (four marks), which will give at least a fair line on its commercial results. On this basis, and with power at 10 cents per kilowatt-hour, one finds, taking the new lamp on its 600-hour rating, that the cost of its 12,000 candle hours, including the lamp, amounts to $3.40. The same number of candle hours from a lamp giving a mean efficiency of 3.25 watts per candle would cost $3.90, exclusive of lamps; that is, the consumer could afford to pay $1 for the new lamp better than to take the old ones free. With power as low as 5 cents per kilowatt-hour, the user of tantalum lamps could afford to pay only 75 cents per lamp, as against getting carbon lamps free. This means that a sliding scale of discounts for lamps according to quality could be made to catch the consumer at all prices ordinarily charged for current by central stations.

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[a] American Inventor, July, 1905.

The writer has examined a number of tantalum lamps and used some for a short time. The light is nearly white, like the Nernst or the acetylene light, and quite agreeable, though it will usually be found too bright unless a ground glass or frosted globe is used. It was noticed that there was more or less tendency for the tantalum filament to snap or break when subjected to an unusually great vibration, especially after the lamp had been used for some time. This difficulty, however, will very probably be overcome with further experiments as the lamp is more fully perfected. As yet it has not been introduced to any great extent in this country, but as it becomes better known it will undoubtedly have a large use. The tantalum lamp does not require any new fixtures, as it fits any socket in which the ordinary incandescent carbon lamp is used.

An interesting occurrence of a tantalum mineral has recently been discovered at the feldspar quarry of Mr. W. F. Patterson, jr., at Henryton, Carroll County, Md., about 28 miles from Baltimore. It occurs in irregular masses and rough crystals in the feldspar, and during the past year a considerable amount of this material was encountered in quarrying, but it was all thrown over the dump, as no one realized what the mineral was or its value. A specimen, however, was sent to the Westinghouse Electric Company at Pittsburg, and a partial analysis by its chemist gives the following result:

Analysis of tantalum mineral from Henryton, Md.

Tantalic oxide (Ta_2O_5)	38.19
Niobic oxide (Nb_2O_5)	13.21
Manganese oxide (MnO)	10.48
Ferric oxide (Fe_2O_3)	21.42
Silica (SiO_2)	12.98

This analysis shows that the mineral contains both tantalic and niobic acid, with a considerably higher per cent of the former. On account of the high atomic weight of the tantalum, the molecular ratio of the tantalic acid to the niobic acid is approximately 3.5 to 2. It may be that the material analyzed has a certain amount of feldspar mixed with the tantalum mineral, which would account for the high percentage of silica. According to a letter received from Mr. Patterson, he will have the dump which has accumulated during the past year worked over for the tantalum mineral that has been thrown away, and all of this material henceforth obtained during the quarrying operations will be saved.

Near Glastonbury, Conn., an old feldspar quarry is being investigated by Mr. Everett B. Hurlburt, of Glastonbury, as to the quantity of columbite or other tantalum mineral that may be found in this feldspar. Years ago when the quarry was worked for feldspar, there was more or less of this mineral found, but no attempt whatever was made to save it.

Some material obtained from Tinton, S. Dak., was concentrated at the concentrating plant at Portland, Oreg., and a heavy black mineral was obtained with cassiterite and scheelite as concentrates from the Wifley table, which, upon analysis, gave 44 per cent of tantalic oxide and 30.5 per cent of niobic oxide, these determinations having been made by Dr. W. F. Hillebrand, of the United States Geological Survey. The specific gravity of the mineral was determined to be 6.8.

In 1904 there was a small production of columbite, one of the tantalum minerals, most of which was shipped abroad; and in 1905 the production was still smaller.

PRODUCTION.

The production of monazite, zircon, and columbite during 1905 amounted to 1,352,418 pounds, valued at $163,908, as compared with 745,999 pounds, valued at $85,038, in 1904, an increase of 606,419 pounds in quantity and of $78,870 in value. The greater part of the monazite was obtained from North Carolina, with the remainder from South Carolina. All the zircon was mined in North Carolina, and the columbite in South Dakota.

The following table gives the production and value of monazite from 1893 to 1902, inclusive; of monazite and zircon in 1903; of monazite, zircon, gadolinite, and columbite in 1904; and of monazite, zircon, and columbite in 1905:

Production of monazite in the United States, 1893–1905.

[Pounds.]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1893	130,000	$7,600	1900	908,000	$48,805
1894	546,855	36,193	1901	748,736	59,262
1895	1,573,000	137,150	1902	802,000	64,160
1896	30,000	1,500	1903	[a] 865,000	65,200
1897	44,000	1,980	1904	[b] 745,999	85,038
1898	250,776	13,542	1905	[c] 1,352,418	163,908
1899	350,000	20,000			

[a] Including 3,000 pounds of zircon, valued at $570.
[b] Including the small production of zircon, gadolinite, and columbite.
[c] Including a small quantity of zircon and columbite.

There has been a constant increase in the production of monazite since 1896, and the demand is increasing as is indicated by the large production of 1905, which approaches the largest production of 1,573,000 pounds in 1895. Where formerly there were but one or two buyers of monazite, there are now ten or a dozen; and the value of the monazite sand has increased very materially.

IMPORTS AND EXPORTS.

As far as can be learned, there were no imports of any of these minerals into the United States during 1905. There has been and continues to be a large importation of thorium nitrate, which during 1905 amounted to 52,378 pounds, valued at $269,504. In the following table are given the quantity and value of thorium nitrate imported into the United States since 1902:

Imports of thorium nitrate into the United States, 1902–1905.

[Pounds.]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1902	42,815	$131,350	1904	58,655	$249,904
1903	64,520	232,155	1905	52,378	269,504

Considerable monazite is exported to Germany; probably from one-sixth to one-fourth of that mined in 1905 was exported to that country.

PEAT.

By Marius R. Campbell.

During 1905 little was accomplished in the practical utilization of peat, although the year witnessed great activity in the way of newspaper articles and theoretical discussions regarding it.

Many State geological surveys have given attention to peat deposits, and several reports have appeared dealing with the subject, but none of them is based upon original work, either in the field or in the laboratory, and hence they have done little toward advancing the knowledge of the subject. The principal use of such publications has been to keep the matter before the public and thereby stimulate private interest and investigation.

The following companies are reported as interested in the development of the peat industry, but many of them have not as yet installed a plant, and those that have completed their installation are not beyond the experimental stage:

Orlando Water and Light Company, Orlando, Fla.
Illinois Peat Fuel Company, Chicago, Ill.
Indiana Peat Fuel Company, Tyner, Ind.
Peat Gas and Coal Company, Portland, Me.
Boston Fuel Company, Boston, Mass.
American Peat and Fuel Company, Capac, Mich.
Capital Peat Fuel Company, Detroit, Mich.
Michigan Peat Company, Chelsea, Mich.
Michigan Peat and Marl Company, Grand Rapids, Mich.
Van Buren Peat Company, Gobleville, Mich.
Wolverine Peat Company, Vicksburg, Mich.
Mankato Peat Fuel Company, Mankato, Minn.
Northern Peat Company, Minneapolis, Minn.
Willmar Peat Company, Willmar, Minn.
American Peat Fuel Company, Lincoln Park, N. J.
Amalgamated Peat Fuel Company, 80 William street, New York, N. Y.
Peat Koal Company, New Rochelle, N. Y.
Lamartine Peat, Light and Power Company, Fond du Lac, Wis.
Western Peat Company, Marshall, Wis.

The production of these experimental plants for 1905 is estimated at 2,000 tons. The work of the Orlando Water and Light Company, of Orlando, Fla., may perhaps be considered typical. There is a popular impression that peat bogs are largely if not wholly confined to northern countries, but this is not correct, since Florida has some of the finest deposits of peat in this country. The Orlando Company is working on a deposit filling a small lake basin. The company has installed a Leavitt machine with a belt conveyor for transporting the peat to the mill, where it is disintegrated and molded into bricks without pressure. The bricks are then laid out, and in the hot Florida sun soon lose a large percentage of their moisture. As the peat comes from the bog it carries about 85 per cent of water, but in a few days after the bricks have been manufactured this is reduced to 30 per cent and finally to about 15 per cent without artificial drying. When the bricks have reached this stage they have shrunk to about one-half their original dimensions, and then they may be stacked out in the weather without reabsorbing an appreciable amount of water.

The business is hampered by the excessive rains which prevail in Florida during the wet season from June to November, and some means of artificial drying or protection must be resorted to before the works can be kept in continuous operation.

Although the plant has not passed the experimental stage, several hundred tons of the machine peat have been produced and used under the boilers of the electric-light plant. It is confidently believed by the owners that peat fuel produced in this way can successfully stand in competition with hard-pine wood at $3 per cord and Alabama coal at $7 per ton.

The most interesting and perhaps the most valuable experimental work that has been done during the year is the practical tests of machine peat as a producer-gas fuel. These experiments were carried on at the United States Geological Survey coal-testing plant at St. Louis on one carload of peat from Massachusetts and another from Florida. The former consisted of part raw and part machine peat, and both kinds were tried in the producer, but the quantity of peat was not sufficient for a thorough test. Although there were many large fragments of wood in the peat, that part which was machined proved to be an excellent producer fuel, making a gas of high calorific power and of even composition. This test was regarded as quite satisfactory; but when raw peat was tried the work of the producer was not satisfactory, for the peat, although dry, burned only where it came in contact with the shell of the producer, and thus the quality of the gas was spoiled.

The second trial was made on a car of machine peat from Orlando, Fla. This gave excellent results, regarding both calorific power and regularity of composition of the gas, also ease of firing.

The results of this test are embodied in the following table:

Producer-gas test of Florida machine peat.

	Peat as fired.	Dry peat.	Combustible.
Pounds consumed in producer.			
Per electrical horsepower:			
Available for outside purposes	2.98	2.35	2.20
Developed at switch board	2.85	2.25	2.11
Per brake horsepower:			
Available for outside purposes	2.53	2.00	1.87
Developed at engine	2.43	1.92	1.79
Equivalent pounds used by producer plant.			
Per electrical horsepower:			
Available for outside purposes	3.16	2.50	2.33
Developed at switch board	3.03	2.39	2.24
Per brake horsepower:			
Available for outside purposes	2.69	2.12	1.98
Developed at engine	2.57	2.03	1.90

Average electrical horsepower	205.0
Average B. T. U. per cubic foot of gas	175.2
Total peat fired .... pounds..	29,250

ANALYSES SHOWING AVERAGE COMPOSITION.

Peat.		*Gas by volume.*	
Moisture	21.00	Carbon dioxide (CO_2)	12.4
Volatile matter	22.11	Carbon monoxide (CO)	21.0
Fixed carbon	51.72	Hydrogen (H_2)	18.5
Ash	5.17	Methane (CH_4)	2.2
	100.00	Nitrogen (N_2)	45.5
Sulphur	.45	Ethylene (C_2H_4)	.4
			100.0

In starting the producer-gas test the entire fuel bed was built up of the Florida peat, and the usual preliminary run was conducted before the official test was begun. The official test lasted 50 hours, and during the entire period no difficulties were experienced either in maintaining the load or in handling the fuel bed.

The test was so thoroughly satisfactory that there is little to report outside of the general results, which will be found of interest to those contemplating the use of this fuel for producer-gas purposes.

Only a small quantity of peat remained after the producer-gas test was made, and on this a steaming test was made which lasted 4.07 hours. This was too short to yield satisfactory results, but owing to the scarcity of such tests the results may be of value. They are as follows:

Steaming test on machine peat from Orlando, Fla.

MISCELLANEOUS ITEMS.

Heating value of peat, B. T. U. per pound of dry peat		10,082
Duration of test	hours..	4.07
Kind of grate		Plain.
Force of draft:		
Under stack damper	inches of water..	0.69
Above fire	do....	.13
Furnace temperature (by Vanner optical pyrometer)	°F..	2,457
Dry peat, used per square foot of grate surface per hour	pounds..	33.49
Equivalent water evaporated per square foot of water-heating surface per hour	do....	4.04
Percentage of rated horsepower of boiler developed		113.2
Water apparently evaporated per pound of coal as fired	pounds..	4.27
Water evaporated from and at 212° F.:		
Per pound of peat as fired	do....	5.00
Per pound of dry peat	do....	6.04
Per pound of combustible	do....	6.63
Efficiency of boiler, including grate	per cent..	577.85
Peat as fired:		
Per indicated horsepower hour	pounds..	5.66
Per electrical horsepower hour	do....	6.98
Dry peat:		
Per indicated horsepower hour	do....	4.68
Per electrical horsepower hour	do....	5.78

ANALYSES OF PEAT USED.

Proximate of peat as fired.		*Ultimate of dry peat.*	
Moisture	17.21	Carbon	57.77
Volatile matter	24.85	Hydrogen	5.18
Fixed carbon	51.01	Oxygen	25.20
Ash	6.93	Nitrogen	2.89
	100.00	Sulphur	.59
Sulphur	.49	Ash	8.37
			100.00

As is seen by reference to the figures, the results secured from this fuel when used under the boiler are exceedingly gratifying. Comparing the dry peat per electrical horsepower per hour required by the two types of plants, it will be noticed that the steam plant used 5.78 pounds, or 2.4 times as much as the producer-gas plant, which required only 2.39 pounds.

The results obtained in the producer plant as well as under the steam boiler compare favorably with those obtained from lignite from North Dakota, as shown by the following table:

Equivalent pounds of dry fuel used per electrical horsepower hour as developed at switchboard.

	Pounds.
Florida peat in producer plant	2.39
North Dakota lignite in producer plant	2.29
North Dakota lignite in producer plant	1.90
North Dakota lignite in producer plant	1.80
North Dakota lignite in producer plant	2.08
Florida peat under a steam boiler	5.78
North Dakota lignite under a steam boiler	5.41

These results show that peat can be much more successfully used for the generation of power in a producer than in a furnace under a steam boiler. Moreover, they show that when used in this way peat may become a successful competitor of coal, even where the latter can be easily obtained.

The possibilities which these experiments seem to open are great, and they may be of infinite value to such States as Florida, Massachusetts, Maine, Minnesota, and Wisconsin, which have little or no coal within their boundaries, but have large deposits of peat that are easily accessible to the commercial centers.

During the year 1905 peat moss, in the form of bales packed under hydraulic pressure, was imported into the United States to the extent of 7,911 short tons, valued at $42,494. This peat moss is used chiefly for stable litter.

PRECIOUS STONES.

By George Frederick Kunz.

INTRODUCTION.

The year 1905 made a record for the importation of precious stones of every variety. This importation was attended by prosperity in every branch of the jewelry business, the sales ranging from the richest gems to those of the poorest qualities, and even to every known form of imitation. This record was achieved notwithstanding the Russo-Japanese war, and was due to general prosperity.

The discovery of utahlite, a green variscite, translucent, golden-green in color, and used as a gem and decorative stone, at a new locality 40 miles southwest from Salt Lake City, 8 or 9 miles west of Stockton, 20 miles northwest of Mercur, and 25 miles northwest of the other utahlite locality in Utah, promises to furnish a quantity of this peculiarly American stone that may be used in semibarbaric jewelry or where a rich but not precious stone is desired.

In the search for and the mining of tourmaline, beryl, topaz, kunzite, and other stones peculiar to the southern counties of California, some wonderful crystals of rose-colored beryl implanted on feldspar and many fine crystals of tourmaline (red and green) are found, and in connection with these occur many specimens of great interest to the science of mineralogy. The region bids fair to excel that of the Ural Mountains, which for more than half a century has led the world in such products. So great has been the interest in California gems and their mining that the State mineralogist, the Hon. Lewis E. Aubury, requested the writer to prepare an illustrated report on the finding, the history, and the cutting of the precious stones of California, with a description of its mines. This volume, numbering 150 pages, illustrated with many plates, is now being issued by the California Bureau of Mines in San Francisco.

In the State of Maine, during 1905, prospecting and slight working was done for gems at Mount Mica, Paris, Auburn, Newry, Mount Black, Rumford, and other mining localities. But only a few gems, tourmalines, were found, and their total value did not exceed a few thousand dollars.

The turquoise mines of New Mexico and Arizona have not been as productive as formerly, but those of California and Nevada have been more so.

Rose quartz from the Black Hills of South Dakota has been cut in great quantity in the form of beads, in Germany, and has been sold over the entire world in competition with rich green aventurine with its sparkling specks of mica.

Amethyst, topaz, malachite, lapis lazuli, amazon stone from Amelia County, Va., and a great variety of stones of all quaint colors have been in greater demand than in 1904. The topaz sold is generally the variety known as "Saxon" or "Spanish" topaz. It is in reality the result of the decolorization of the smoky quartz found in Spain, Brazil, and Colorado, and according to the amount of unexpelled color, it is straw-colored, amber-yellow, or rich reddish-brown. So much demand has existed for the true Brazilian yellow topaz and the pink topaz, the latter produced by heating the Brazilian yellow, that the opening of the original mines at Ouro Preto in Brazil is under discussion.

A novelty in the gem line has been the cutting of the chrysoprase, so extensively found at Visalia, Tulare County, Cal., in its iron-brown and dark-brown matrix, which forms a pleasing contrast to the golden-green color of the chrysoprase.

Highly colored gems, green, red, yellow, and purple, have been in great demand, so much so that many thousands of peridots of Arizona origin have been cut, and many times more of those from Egypt. This is equally true of the California tourmalines, pink and red, and also of those from the Urals and from Madagascar and Brazil. So great has been the demand for amethyst that the remainder of the great finds in Brazil, in 1900, and also stones from every available source have been cut, frequently into pear-shaped and diamond-shaped stones.

The emerald is still the gem in evidence. At no time has it received so high appreciation as to price. It is more than ever in demand, for the supply has been only in part sustained by the yield of the mines in the United States of Colombia. Part of the gems have been cut in the United States from the rough stones shipped directly to the firms doing the cutting. Many of the finest gems were undoubtedly taken from old jewels by the owners on the inducement of the high prices obtained.

The pearl is in as great favor as ever. The English Government has published the results of the investigations of the experts who have studied the life history of the pearl oyster, its parasites, its enemies, and the methods of further increasing its production. The present demand is causing a drain upon the Ceylon pearl banks, which have always yielded so great a revenue.

Within the last two years, and with the introduction of Louis XV and Louis XVI designs in jewelry, there has been immense improvement in lapidary work in the United States in every variety of stone. No better lapidary work has ever been done at any period, and every intricate form of cutting and polishing such gems as aquamarines, tourmalines, peridots, kunzite, amethyst, and similar stones has been employed, including not only the round but the oblong, hexagonal, octagonal, marquise, pear-shaped, and other forms set with borders of small brilliants. There has been especial preference for many of the larger stones; and never have aquamarines, tourmalines, and amethysts been sold in such profusion. Probably $100,000 worth of aquamarines from the Brazilian locality found two years ago have been used.

DIAMOND.

UNITED STATES.

There are four regions where diamonds have been met with in the United States. These are (1) the Pacific coast, chiefly along the western base of the Sierra Nevada, in the central counties of California, associated with gold in the cement gravels; (2) along the line of the moraine of the ancient ice sheet in Wisconsin, Michigan, Indiana, and Ohio; these have been transported from an undiscovered source, presumably somewhere in Canada; (3) Kentucky and Tennessee; (4) the Atlantic States from Virginia to Alabama, chiefly along the eastern base of the Appalachians in what is known as the Piedmont region. The actual place of origin of the diamonds is in all these cases unknown. Those of the Pacific coast and the Atlantic States have been derived by erosion from the adjacent mountain ranges, but the original sources have never been discovered. Those of the northern drift have doubtless come from beyond our borders, in Dominion territory, and their exact source is entirely a matter of speculation. The few occurrences in Tennessee and Kentucky are not as yet definitely traceable, even in theory. All have been found in loose and superficial deposits, and all accidentally. Most of those in the Atlantic and Pacific regions have been met with in washing for gold.

This subject of the occurrence of diamonds in the United States has been treated in some detail by the writer in a report to the United States Geological Survey, to be issued in the near future.

SEARCH FOR DIAMONDS IN BLACK SANDS OF THE UNITED STATES.

The high price of diamonds has made the search for these precious stones in the United States and Canada keener than ever before. In the examination by the United States Geological Survey of many samples of gold and platinum sands during the Lewis and Clark Exposition at Portland, Oreg., diamonds were carefully looked for. Diamonds have been watched for also by a number of parties that have been dredging for gold on an extensive scale in the rivers of California, but in neither case have any finds been reported.

INDIANA.

Minerals of the Indiana drift in relation to their supposed Canadian source.—The only well-attested diamond discoveries in the drift region of the United States during the last four years have been those in connection with the gold washings of Brown and Morgan counties, in southern central Indiana. The writer has taken special pains to obtain a full series of specimens of the rocks and minerals found in the gold-bearing drift of this region from Mr. George C. Royce, of Martinsburg, W. Va., and Professor Blatchley, State geologist of Indiana, and others, for the purpose of having them compared with the rocks in Canada, north of the Great Lakes, with a view to tracing out, if possible, the source whence the diamonds came.

With the hope of aiding in the solution of this problem the collections of drift minerals and rocks from the diamond section of Indiana were sent to Canada for examination and were laid before the Ottawa meeting of the Geological Society of America in December, 1905. Considerable discussion was awakened, but no very definite results have as yet been reached.

Among those who examined the specimens at the meeting with particular interest and expressed opinions thereon are the following Canadian geologists: Dr. A. E. Barlow, Mr. W. J. Wilson, and Prof. H. M. Ami, of the geological survey of Canada; Prof. W. G. Miller, of the Ontario Bureau of Mines; Dr. G. A. Young, petrographer, and subsequently in more detail, Prof. Frank D. Adams, of McGill University, at Montreal. All these gentlemen were especially qualified to judge of these materials by intimate acquaintance with the geology of the region under consideration and its glacial phenomena.

Doctor Barlow and Mr. Wilson recognized a number of the fragments in the collection from the Indiana drift as apparently identical with rocks familiar to them at various points in northern Ontario. Especially marked was the prevalence of pieces and rolled pebbles of jasper and jaspilite, characteristic in association with the iron ores of the Michipicoten and other iron ranges north of Lake Superior.

After the meeting of the geological society the material, consisting of some 30 samples, was sent to Prof. F. D. Adams, of McGill University, for more detailed examination. In these 30 samples there were more than 200 specimens, every one of which was carefully examined by Professor Adams, who then divided them into groups clearly definable. These groups and the percentages which they represent he states as follows:

1. Laurentian gneiss	14.4
2. Quartzite	29.8
3. Chert and jasper	32.7
4. Iron ore	9.6
5. Amphibolite and green schist	6.3
6. Trap, two types	.8
7. Sandstone, etc.	4.0
8. Limestone and shale	2.4
	100.0

No. 1 is represented by characteristic material, much of it evidently coarse pegmatite, rich in feldspar.

Nos. 3 and 4 are certainly, and Nos. 5 and 6 probably, from the iron ranges of the Huronian or Keewatin.

The pieces numbered 7 seem to be partly Keewenawan and partly Huronian, while those included under 8 are distinctly Paleozoic.

It thus appears that the portions decidedly referable to the iron ranges of the Huronian and Keewatin (Nos. 3 to 6, inclusive) make up nearly half of the whole material (49.4 per cent), while the quartzite, No. 2 (29.8 per cent), is largely Huronian. These rocks are widely developed north of the Great Lakes and at no great distance from them.

KENTUCKY.

There has been some revival of speculation as to the existence of diamonds in the peridotite dikes of northeastern Kentucky. Mr. D. Draper, a Transvaal geologist, has visited the celebrated dike at Ison Creek, in Elliott County. The lessees or owners have under consideration a plan to work a large part of this tract with diamond machinery like that used at the South African mines, and apparently this entire tract of land has been bonded and the parties engaged are endeavoring to proceed to work the place extensively, although up to the present time no definite proof exists of the occurrence of diamonds in this region. The examination made there by the Kentucky Geological Survey, under the late Prof. John A. Procter and Doctor Crandall, and also that made by Mr. J. S. Diller and the writer seventeen years ago, were both without result. Recently Mr. W. C. Phalen, of the United States Geological Survey, visited the region and spent some time in the preparation of an economic bulletin on the Kenova quadrangle. He located a new outcrop of the peridotite, but was unsuccessful in obtaining any diamonds. He heard at Grayson, Carter County, that a diamond or two had been found in the Ison Creek district, but he could not verify the report.

NEW YORK.

Diamonds in drift.—In the article of Prof. William H. Hobbs, on "The Diamond Field of the Great Lakes," published in 1899,[a] emphasis was laid on the

[a] Jour. Geol., vol. 7, No. 4, May-June, 1899.

desirability of careful search for diamond occurrences on the moraine line east of Ohio—in Pennsylvania and New York—as a further guide to locating the original northern starting point. No similar discoveries have since been made, except those in central Indiana, until recently a report has appeared of one or perhaps two diamonds being found near Syracuse, N. Y. An account of these and a discussion of the bearings of the whole subject were given by Mr. Philip F. Schneider, of that city, in the Syracuse Herald[a] of December 24, 1905. The topic had been presented previously, by Mr. Schneider and others, at the October meeting of the Onondaga Academy of Sciences. Unfortunately the facts are not capable of positive proof at the present time. The owner of the gravel-pit in the southern part of Syracuse claims to have found a diamond therein several years ago and to have subsequently sold it for $1,700 to a person living at Springfield, Mass. The purchaser has since died, and his relatives are in Europe, so that it is not possible at present to verify the account. The same owner also reports finding another smaller diamond, which he still retains; but Mr. Schneider questions its reality, and suspects it to be only a quartz crystal.

The geological interest of such an occurrence and its inherent probability in connection with the western diamonds of the drift make these unverified reports worth recording.

In Mr. Schneider's article he also treats of the possible relation of these diamonds, if such they should prove to be, with the peridotite dikes in and around Syracuse. It will be remembered that this rock, altered to serpentine, was identified by the late Prof. H. Carvill Lewis with the rock at Kimberley, South Africa, and with that in Elliott County, Ky., all three being included under his name of kimberlite.

This close relationship to the South African diamond-bearing rock has led to speculation and may lead to possible diamond production at the Kentucky and the Syracuse localitites, especially as both these latter have yielded pyrope garnets similar to those freely obtained at Kimberley, and there known as "Cape rubies." No diamonds, however, have been definitely found as yet at either of the American kimberlite occurrences; but if any should really be obtained near Syracuse, the question may be raised whether they are derived from the drift or from the kimberlite dikes of the vicinity.

CANADA.

Search for diamonds.—Dr. H. M. Ami, of the geological survey of Canada, has given careful instructions to a hundred or more parties that are surveying for the Transcontinental Railroad, immediately north of the Great Lake region, how to look for the diamonds in the hope of their locating the source of the diamonds which have been found in the glacial deposits of Wisconsin, Michigan, Ohio, and Indiana.

SOUTH AFRICA.

De Beers Consolidated mines.—The most prominent feature in the seventeenth annual report of the De Beers Consolidated mines, for the year ending June 30, 1905, laid before the meeting of the shareholders at Kimberley, in November, is doubtless the retirement of Mr. Gardner F. Williams from the office of general manager, which position he has held and administered with signal ability and

[a] Syracuse Herald, December 24, 1905.

success for the last nineteen years. He has for some time desired to be relieved from the cares of this position, and he will now be succeeded by his son, Mr. Alpheus F. Williams, who has been assistant manager for several years, is thoroughly familiar with the situation, and has ably conducted the working of this great mine in the several absences of his father in the United States.

In regard to the output of the year, it presents no very marked differences from that of the year 1904. There is some advance in total production, due to the increasing yield of the two newer mines, the Bultfontein and the Dutoitspan; but the old mines show a continued falling off. On the other hand, the Bultfontein and Dutoitspan have developed a sudden advance in richness, the yield per load of these two mines taken together being some 40 per cent above that of the year before. The other mine, previously known both as the Premier and the Wesselton, remains about the same in rate of production. This mine is spoken of in the present report only as the Wesselton, the name Premier being apparently discarded, and wisely so, in view of the prominence assumed by the great Premier mine near Pretoria in the Transvaal.

The combined data for the De Beers and Kimberley mines are as follows:

Production of De Beers and Kimberley mines in 1904 and 1905.

	1904.	1905.
Loads of blue hoisted	2,440,895	2,447,850
Loads of blue washed	2,401,099	2,418,158
Carats of diamonds found[a]	1,303,525	1,108,980
Value of diamonds found[a]	£3,192,798	£2,929,589
Number of carats per load	0.54	0.46
Value per carat[a]	48s. 11d.	52s. 10d.
Value per load[a]	26s. 7d.	24s. 3d.
Cost of production per load[a]	7s. 4d.	7s. 8d.
Loads remaining on floors	2,175,079	2,204,771

[a] Fractions omitted or approximated.

It will be seen from these figures that the continued rise in value has again failed to counteract the decrease in richness, as shown by the diminished value per load. The quantity of blue ground reported as in sight in 1904 in these two mines was 9,987,908 loads; in 1905 it was 8,026,400 loads—a decrease of about one-fifth.

Of the three newer mines the Wesselton furnished the maximum quantity of blue ground, 2,068,278 loads; and it yielded also one diamond of 187½ carats, the largest yet found in this mine. The Bultfontein leaped from a yield of 0.29 carat per load in 1904 to an average of 0.41 in 1905. This yield rose further during the latter half of the year, and a test from the east end of the mine area gave, in 32,122 loads, an average as high as 0.523 carat. The Dutoitspan mine more than doubled its former average yield, having risen from 0.12 to 0.26 carat per load. In quality the diamonds from this mine are far above those from any other. All three are still worked more or less as open mines.

The data for these mines for the last two years are as follows:

Production of the Wesselton, Bultfontein, and Dutoitspan mines in 1904 and 1905.

	Wesselton.		Bultfontein.		Dutoitspan.	
	1904.	1905.	1904.	1905.	1904.	1905.
Loads hoisted	1,919,304	2,068,278	429,729	605,730	39,914	311,499
Loads washed	2,134,903	2,032,582	514,385	611,491	24,359	65,784
Diamonds found (carats)[a]	605,241	578,152	148,219	249,002	3,032	17,121
Value of same[a]	£1,055,269	£1,067,475	£219,711	£434,902	£6,457	£59,847
Carats per load	0.28	0.284	0.29	0.41	0.12	0.26
Value per carat[a]	34s. 10d.	36s. 11d.	29s. 7d.	34s. 11d.	(b)	69s. 11d.
Value per load[a]	9s. 10d.	10s. 6d.	8s. 6d.	14s. 2d.	(b)	18s. 2d.
Cost per load[a]	3s. 7d.	3s. 10d.	5s. 9d.	5s. 10d.	(b)	12s. 3d.
Loads on floors	1,356,260	1,391,956	397,503	391,742	15,555	261,270

[a] Fractions of pounds, carats, and pence omitted or approximated. [b] Data not given.

The quantity of blue ground in sight at these mines was estimated as amounting to 51,300,300 loads. This amount being added to that given above for the De Beers and Kimberley—8,026,400—the entire total foots up 59,326,700 loads. Beyond this, however, there are of course the unexplored resources of the three newer mines which have only been opened to depths from one-fourth to one-third those of the older mines.

The recovery of diamonds from tailings and débris has continued, though on a scale somewhat less than in the previous year, which was the maximum. In 1905 1,616,030 loads were washed, mostly from the De Beers mine, and there were obtained 257,059 carats of stones, valued at £311,030.

Even with the higher rate realized for rough diamonds, the earnings of the De Beers Company were 15 per cent less than in 1903, as the average yield of rough diamonds from the De Beers and Kimberley mines has fallen from 0.76 carat per load in 1902 to 0.61 carat per load in 1903 and to 0.46 carat per load in 1905. Great quantities of the poorer diamond earth were treated. The total sum realized from the sale of diamonds was £4,802,844; the expenditures were £2,937,509; the profits were £1,865,335. Out of the profits £1,800,000 were paid in dividends, the dividends being 20s. per preferred share as against 27s. 6d. in 1903 and 1904. The reserve was £846,783. The entire sales in 1905 were made "rough" by the syndicate, and this is to continue in 1906, on account of the lower yield and on account of the great demand. This is in spite of the fact that the price of rough stones was raised twice, 5 per cent each time, during the year 1905; but the diamond syndicate makes these advances because there are less diamonds found to-day than there were found fifteen years ago, while the demand for them has greatly increased.

Premier (Transvaal) mine.—The increased output of the Premier (Transvaal) mine has caused great interest in the production of diamonds; and the finding of the largest known diamond, the Premier or Cullinan, weighing 3,024 carats, and of several other large stones, one of which weighed over 600 carats and another 340 carats, has given this mine the greatest record for producing material of exceptional size.

Orange River Colony mines.—The extensive development of diamond mining in the Orange River Colony is well shown in the Annual Report of the Mines Department of that Colony for the year ending June 30, 1905.[a] This report, by

[a] Mines Dept. Orange River Colony, Ann. Rept. for the statistical year ending June 30, 1905; Bloemfontein, 1905, p. 31.

Mr. Burnet Adams, acting chief inspector of mines, tells of steady increase in the diamond output of the colony and describes the condition of the producing mines, besides the Vaal River alluvial diggings, and of more than fifty prospects and partially developed undertakings. In regard to these latter, many have proved disappointing, but some have yielded good diamonds and may prove to be valuable properties.

The seven mines that have actually yielded more or less successfully are (1) the New Jagersfontein (the old celebrated mine reorganized under the new government); (2) the Koffyfontein; (3) the Ebenhaezer; (4) the Lace Diamond Company; (5) the Monastery; (6) the Kaalvallei; (7) the New Driekopjes. Of these, the last is now closed and for sale, and two or three of the others are partially suspended and either engaged in testing or in awaiting improved appliances. The Jagersfontein is much the most important and has been steadily advancing, both in equipment and in production. Heretofore it has been carried on as an open working, but steps are now being taken to change to the underground system, as was done with such success in the De Beers and Kimberley mines.

The diamond output of the colony for the year covered by the report is given in a tabular form by months, from July, 1904, to June, 1905, inclusive. These show some variations, but maintain a fairly uniform average. The product is given as a whole, without distinguishing the mines, but the Jagersfontein far exceeds all the rest together.

Output of diamonds in Orange River Colony, fiscal year ending June 30, 1905.

Loads washed	3, 556, 000
Carats of diamonds found	320, 548½
Value of same	£938, 617, 15s. 6d.
Carats per load	0. 0899
Value per carat	58s. 8d.
Value per load	5s. 3d.

Subsequent data for the month of July, 1905, show but slight differences from the average of the month preceding. The cost of mining per load is not given in the report.

On comparing these figures with those of the De Beers group of mines at Kimberley for the same period, it is seen that the blue ground is comparatively very low in its diamond content, but that the average value of the stones per carat is considerably higher than for those of the richest of the other group—the De Beers and Kimberley. The total number of loads washed is nearly two-thirds that of all the De Beers group together; while the total diamond product is less than one-sixth, but its value exceeds one-fifth.

The average number of men employed in the diamond mines of the colony, month by month during 1905, was 526 whites and 4,659 natives. With some fluctuations there has been a general increase of the total number during the year, from 4,458 in July, 1904, to 5,496 in July, 1905. The average monthly wages paid for mining and prospecting in the Orange River Colony are given in a recent article as £20 7s. 7d to white men and £3 1s. 6d. to natives.[a]

BRAZIL.

Diamonds and carbonado in Bahia.—Considerable space has been given in recent reports of this Bureau to the diamond and carbonado industry of Brazil. An important article has appeared within the last year on the geology of the

[a] Jewelers' Circular Weekly, October 11, 1905.

Bahia region by Prof. Orville A. Derby, who was engaged by the State of Bahia to study the geological occurrence of the carbonados. The article in question is his report of this work, and has been translated into English by Prof. John C. Branner for publication in this country.[a]

The region examined was the basin of the Paraguaçu River, the upper part of which contains the Chapada Diamantina, or diamond plateau of Bahia. The river traverses four regions or belts of entirely distinct geological character. The first of these takes in all the headwaters of the Paraguaçu and its main affluent, the Santo Antonio; the second reaches from the Falls of Passageni de Andarahy, some 50 miles, to Bededouro; the third extends about 200 miles, down to Maragopipe, and the fourth is a narrow belt adjacent to the coast.

The diamonds and carbons are characteristic of the first region, and occur occasionally in the second and third. At all the localities examined by Professor Derby they appear in connection with a thick bed of conglomerate about the middle of the hard sandstone formation. In many places, indeed, he states that the gravels worked for diamonds are simply this same conglomerate decomposed in place, and not a more recent superficial deposit. This fact has already been recognized in the State of Minas Geraes, where also, at Grao Mogol, diamonds have been taken from the hard conglomerate itself. It is clear that in Brazil the conditions of diamond occurrence bear no resemblance at all to those in Africa. All the indications point to the conglomerate as the source of the diamonds, and the recent unconsolidated gravels are richest in the vicinity of outcrops of this rock, which miners call *pedra cravada*.

If this determination of the conglomerate as the home of the diamonds be correct, Professor Derby remarks, the supply must be enormous, and all that has been done heretofore is trivial in comparison. Only a small part, however, of the deposits can be worked with the methods in use thus far. Whether modern scientific processes, using the hydraulic power so abundant in the region, can operate the beds at an actual profit remains a question for future solution.

Elsewhere than in the vicinity of the Serra das Lavras and its conglomerate there are few diamond occurrences, but still some are known that have interest. Along the bed of the Paraguaçu, in particular, there are various points where diamonds are obtained by diving, and some of these are so far from the Serra that it is not easy to see how the source can be so distant. The principal locality is at the Falls of Funil, near Bebedouro, on the eastern edge of the second region or zone mentioned above. Here the fall is formed by a heavy bed of conglomerate resembling the one in the first zone, but almost certainly of later age. It rests upon granitic rocks and its pebbles are largely thence derived, so that the "formaçao," or diamond gravel, is quite different from that of the first zone. The sandstone of the second zone, however, must be largely derived from the first, and the contained diamonds may be thus accounted for.

These accounts should be compared with that by Mr. H. W. Furniss, dealing with the same region and reviewed in the report of this Bureau for 1902.[b]

There is another diamond region in Bahia—that of Cannavieras and the valley of the Pardo River, and the southern part of the State.[c] This, Professor Derby remarks, is the only diamond occurrence in Brazil at all near the sea. It is a region of but slight elevation, only about 100 meters, largely wooded, and with a thick soil that obscures the rocks. At points, however, in the val-

[a] Econ. Geol., vol. 1, No. 2, Nov.–Dec., 1905, pp. 134–142.
[b] Mineral Resources U. S. for 1902, U. S. Geol. Survey, 1904, pp. 816–822.
[c] Ibid, p. 816.

leys of the Pardo and the Salobro a heavy conglomerate with granitic pebbles is exposed near the diamond washings. One diamond of three grains was obtained for Professor Derby in a test made on 1½ cubic meters of decomposed conglomerate selected by him. Thus, again, diamonds are apparently traced to a widespread bed of conglomerate, here quite near the coast, easily recognized, and suggesting extensive possibilities for investigation and development.

NEW SOUTH WALES.

A valuable guidebook to the mines and minerals of New South Wales has lately been issued under the direction of the minister for mines and agriculture in that colony, Hon. S. W. Moore.[a] In this work references are made to the occurrence of diamonds at several points, which have been noted from time to time in former reports of this Bureau.

The more recent and more important diamond districts around Bingara and Inverell are situated near the Queensland border. Bingara is 378 miles north of Sydney, and Inverell and Tingha are both nearly 40 miles east of Bingara. The divisions named from the two latter places contain much tin in the drift, while the Bingara division is worked principally for gold. With regard to diamonds in particular the guidebook says that near Copeton, in the Inverell district, are numerous isolated hills capped with basalt, beneath which are sands and gravels, with tin, diamonds, and some gold. These hills have been variously named, one of them being the celebrated diamond locality of Boggy Camp. It was in this district that the discovery of two small diamonds in a basaltic dike was made in 1904 at Oakey Creek, near Copeton.

The Bingara division presents conditions somewhat similar, yet with some differences. The chief diamond yield has been from patches of gravel capping the foothills of the basalt-covered range some five miles to the southwest of Bingara.

It is in the Bingara district, at Ruby Hill, that the eclogite-bearing pipe was observed in 1902, which led to so much discussion as to eclogite being the probable source of the diamonds.[b] The guidebook states that there has been but little activity of late in these fields owing to low prices for the diamonds, which are all of small size.

The statistics for New South Wales, given in this volume, state the diamond yield for 1904 as 14,296 carats, valued at £11,620, and the total production to the end of that year as 147,955 carats, valued at £98,223 17s.

Large diamond at Mount Werong.—The fact, after years of working at various points, that only small diamonds had been found, led naturally to the belief that no large diamonds were to be expected in Australia. Within the past year, however, a diamond of nearly 29 carats has been discovered at Mount Werong, 136 miles west of Sydney and 30 miles south of Oberon. It was found at a depth of 12 feet by two gold miners, who were not diamond miners and who did not know what it was. They kept it for some months, and were offered a few pounds for it on two occasions, but suspected that it might be more valuable. Finally it was sent to the state department of mines at Sydney, where it was recognized at once, and its value then proved to be £200. The stone is a distorted and flattened crystal, measuring 23 by 15 by 5 mm., flawless, and of a straw yellow. Appreciating the importance of this discovery, Mr. E. F. Pittman, of the department of mines, promptly visited the place and made a report

[a] A Guidebook for the Use of Prospectors in New South Wales; Sydney, 1905, pp. 156, with map.
[b] Mineral Resources U. S. for 1902, U. S. Geol. Survey, 1904, pp. 824–826.

upon it, which is reviewed by Mr. John Plummer in the Mining World of October 21, 1905.[a]

Mount Werong is one of the peaks of the mountain range, some 4,000 feet high, which separates the fertile coast region from the arid interior. In the beds and ravines of the streams that drain the ridge much of the drift gravel is found washed down and redeposited, and here occurs gold, with zircons and sapphires, abundant but small, and also this large diamond, and another found some years ago, and valued at £5. The sapphires have undoubtedly come from the decomposed basalt overlying the drift, as none have been found in the drift itself. The diamond Mr. Pittman refers to the drift; but he also recognizes the possibility of its having come from the basalt, in view of the discovery of one or more diamonds in the somewhat related dolerite at Copeton. This new locality is some 300 miles south of the Inverell and Bingara region.

NOTES ON THE DIAMOND.

Russian experiments in crushing carbons used in diamond drills.—Prof. Alex. M. Mitinsky, of the Mining Academy of St. Petersburg, Russia, is carrying on a very interesting series of experiments in crushing the carbons used in diamond drills.[b] The rate of advance of a diamond drill increases with the pressure up to a point where the diamonds are likely to break. Here the limit is reached, beyond which an economic loss is involved by greater pressure. The object of this investigation was to determine this limit, which had not before been done, and which is of course a very important practical question.

There has been hitherto a remarkable difference in the practice of European and American operators in work of this kind. The former have generally followed an empirical rule of applying a pressure of 2 kilograms per square centimeter on the bottom of the drill, which is equivalent, with ordinary tools, to 1 kilogram per square millimeter on the diamonds. American drillers have used far higher pressures, as much as 50 or 60 kilograms per square centimeter; by the same ratio this would give 25 to 30 kilograms per square millimeter on the stones set in the drill.

Professor Mitinsky, assisted by Mr. S. Woisslaw, the pioneer of diamond drilling in Russia, selected a number of carbons and subjected them to pressure tests. This was done by placing each stone between two metal plates, a harder one representing the rock and a softer one representing the tool. These were connected with a very sensitive press and recording apparatus, with a maximum load of one metric ton. Different metals and different grades of steel were tried, and the half-sum of the areas of the impressions made in the two plates, in each test, was taken as the cross-section area of the diamond that had been pressed into them for calculation of the force exerted per square millimeter of the stone. The first test was to the limit of the press, one metric ton, without breaking, and the determination was 54.3 kilograms per square millimeter. The second stone, a small one, broke at a calculated pressure of 80.6 kilograms per square millimeter. Three other tests had an average of 68 kilograms as the breaking limit, the lowest being 56 kilograms.

These experiments, Professor Mitinsky thinks, show clearly that the pressure on drilling tools can safely be much increased with corresponding advantage in results, and that the Americans, although far in advance of the Europeans, have yet been operating well within the limit of practical advantage.

After these tests Mr. Woisslaw directed his workmen to disregard the risk of breakage and to use the highest pressure attainable with their machinery.

[a] Min. World, Oct. 21, 1905.

[b] Eng. and Min. Jour., Dec. 16, 1905.

Professor Mitinsky states that the results were very good, and adds that by this method tools can be obtained that can be run safely at a rim speed of 25 meters per second.

Diamond-carbon in meteorites.—Following up his researches on the Canyon Diablo meteorite, Prof. Henri Moissan has published a more extended article describing those researches in fuller detail and also certain conclusions thence derived, together with new experiments as to diamond production.[a] The results shown are (1) that it is only in certain specimens of this meteorite that carbon appears at all; (2) that in some pieces it is present in several forms, as amorphous carbon in two or three distinct varieties, as graphite, and as diamond in two varieties, black and transparent; (3) that these latter are found inclosed in or surrounded by a zone of amorphous carbon and in small fissures which stand in close relation to nodules of troilite and other compounds containing phosphorus and silicon in addition to the sulphur. Microscopic examination shows that even the portions of the iron that appear homogeneous frequently contain small nodules of this character. Professor Moissan judged, from various studies by himself and others, that the metalloids—silicon, phosphorus, and sulphur—all tend to displace the carbon from molten iron, and that an increase in the proportion of nickel, which is found to vary considerably in different parts of the meteorite, lessens the solubility of carbon in the alloy as compared with pure iron. These two conditions, therefore, should cooperate to favor the separation of carbon in such a meteorite, as compared with Professor Moissan's former process of diamond production in the electric furnace.

These suggestions led him to undertake a series of new experiments to test the effect of conditions thus modified. These are described in much detail, with the general result that the addition of small quantities of monosulphide of iron, or of silicon, to the crucible of melted iron with carbon, on its removal from the electric furnace and just before its immersion in cold water, appeared to facilitate the production of minute diamonds similar to those of his former experiments, but in larger number and with slight crystallographic differences. The addition of a small percentage of nickel, on the other hand, produced no apparent change from the results with pure iron. The introduction of phosphate of iron not only failed to increase the quantity of diamonds but apparently lessened it. Professor Moissan therefore concluded that the diamond carbon in the Canyon Diablo meteorite has probably been set free from an iron carbide by the action of sulphur, and to some extent of silicon, the latter having also partly united with the carbon to form the silicon carbide which he found in association and which the writer named Moissanite, the natural form of the artificial product carborundum.

The crystallographic features of the microscopic diamonds are described, and the very interesting fact is noted that in a number of instances the little crystals broke spontaneously days or even weeks after their formation, thus presenting a striking parallel to the occasional behavior of diamonds from the blue ground of South Africa.

Considerable space is given to experiment and discussion as to the action of melted iron in solidifying in respect to expansion or contraction. The fact seems clearly shown that pure iron follows the ordinary law, but that iron with dissolved carbon expands in passing to the solid state, producing when confined the enormous pressure which causes the carbon, or some part of it, to crystallize as diamond, instead of all assuming the amorphous or the graphitic form.

Artificial production of diamonds.—Two processes have been announced by German experimenters whereby it is claimed that minute crystals of diamonds

[a] Nouvelles recherches sur la réproduction du diamant, par Henri Moissan: Ann. de chimie et de phys., 8th ser., vol. 5, June, 1905.

have been obtained. One of these is that of A. Ludwig, who has been able to produce such crystals from pulverized carbon heated in hydrogen on a spiral of iron wire in the electric arc under a pressure of 3,100 atmospheres.[a] The other is announced by R. von Hatslinger, who fuses graphite with silicates. He prepares a mixture representing as nearly as possible the composition of the African blue ground, and then introduces powdered graphite. The whole is melted in a crucible, the process being facilitated by using metallic aluminum and magnesium in preference to the oxides of those metals. When the fused mass is dissolved, minute octahedra are found, possessing the physical properties of diamond.[b]

Effect of radium on the diamond.—Sir William Crookes delivered his notable lecture on the subject of the diamond before the British Association for the Advancement of Science at its Kimberley meeting in September, 1905. In this lecture experiments were described in connection with radium in contact with the diamond, which showed that the beta rays from radium preparations had like properties to the streams of inactive electrons in a radiant matter tube. It was found, by exposing fine colorless crystals of diamond to radium bromide undisturbed for more than twelve months that the radium caused the diamonds to assume a beautiful bluish color. This color is very persistent; it was affected neither by heating in strong nitric acid nor by potassium chlorate. Furthermore, the radium had communicated to the diamonds radio-active properties strong enough to affect a photographic plate; and when they were heated to a dull redness in a dark room a faint phosphorescence spread over the stone just before the color became visible.

Sir William Crookes also announced the results of his experiments in examining the extreme hardness of the metal tantalum, produced by Messrs. Siemens Brothers, of Berlin. He found that a diamond drill making 500 revolutions per minute and continued in operation for three days and nights had only produced a depression of one-fourth millimeter in depth, the question being then as to which had been affected the more, the diamond or the tantalum.

Wages in diamond-cutting industry.—For the last two years there has been a great deal of disturbance in the matter of the adjustment of the rates and hours of labor in the diamond-cutting industry. The outcome for the United States has been that in November, 1905, an eight-hour day was established, with wages ranging from $40 to $80 per week for the various employees in the industry. This result was brought about by the great demand for cut material and by the fact that the amount of cutting in the United States has increased so rapidly within the last five or six years that at the present time more than one-half of all the diamonds sold in the United States have been cut here. As the high quality of the cutting is not excelled in any of the foreign centers, and because of the systematic methods in use in this country, there is a possibility of a still greater percentage of the larger stones being cut here. This is not true of the smaller stones.

CORUNDUM GEMS.

CORUNDUM.

NORTH CAROLINA.

The first volume of the North Carolina Geological Survey reports[c] treats of the history of corundum mining both as an abrasive and as gem material.

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[a] Chem. Zeitung, XXV, 1902, p. 979.
[b] Monatsh. Chemie, XXXII, 1902, p. 817.
[c] Pratt, J. H., and Lewis, J. V., Corundum and the peridotites of western North Carolina: North Carolina Geol. Survey, vol. 1, 1905.

Mining for the abrasive has been frequently successful, but, although the gem mining has produced interesting results, there never has been a financial return to warrant the expenditure for this purpose.

INDIA.

In his recent review of Mineral Production in India for the years 1898 to 1903,[a] the Director of the Indian Survey, Dr. T. H. Holland, gives data supplementary to his special treatise on the occurrence of corundum. Corundum is widely distributed throughout the Mysore State, and a certain amount of working is done at several points, though it can hardly be called mining. There has long been a local trade and a local consumption in India; but Doctor Holland doubts if it will ever be profitable to develop the workings on a large scale, in view of the competition of foreign corundum and of cheap abrasives like carborundum. The native demand, that of the old *saikalgar*, or armorer, and the lapidary, is mainly at a few points like Delhi, Agra, and Jaipur, and has been supplied by the irregular and casual gathering by agriculturists and cowherders. The data of production in Mysore are very variable and evidently imperfect, ranging from 28 tons to 150 tons, worth from about £100 to £700.

CEYLON.

With regard to corundum in Ceylon, the Report of the Mineralogical Survey of that Island for 1904,[b] by the Director, Mr. A. K. Coomeraswamy, gives quite a full account, divided into two sections, one on corundum for abrasive use, and the other on the gem varieties. The first part deals in some detail with the occurrence of blue crystals in the soil at Haldummulla, mentioned in Mr. Coomeraswamy's paper on the Rocks and Minerals of Ceylon.[c] The crystals on the Haldummulla estate have been traced over a considerable area to the foot of a steep jungle-covered bluff, impossible to explore without heavy cost, but clearly the source of the loose corundum. The crystals are accompanied over the area examined by pieces of the matrix, which is sillimanite rock with garnets, containing corundum crystals identical with the others. Orthoclase microperthite is associated to some extent, and a little of either rutile or ilmenite, but these never appear together.

The second part of the report, on the Ceylon gems, is the fullest that has appeared for some time. The gem corundums of Ceylon are obtained entirely from gravel beds, together with lower grades of corundum and also spinels, zircons, tourmalines, beryls, topazes, etc., that have long been known as Ceylon gems. Most of these are supposed to have come from the intrusive granite rocks of the Balangoda group, but tourmaline alone has actually been found in a granite matrix on the island. The hills and ridges are so covered with jungle that it is well nigh impossible to trace the sources of the minerals brought down by the streams. The gems and other heavy minerals thus transported are to a large extent very local in distribution, indicating that their sources are in many small outcrops.

The "gemming" industry of Ceylon is described at some length, with maps and illustrations. The stones are all found in a bed, or sometimes in two beds, of rounded quartz pebbles and cobbles, called "*illam*," which is widely distributed through the valleys and lowlands beneath a more or less thick deposit of alluvium of varying character. The *illam* is sometimes above the level of the

[a] Geol. Surv. India, vol. 32, pt. 1, 1905, p. 105. See also vol. 30, pt. 3, 1901, p. 169.
[b] Ceylon Administration Repts., 1904; Mineralog. Survey, pp. E-1, E-3, E-11, and E-19.
[c] Rocks and Minerals of Ceylon, Spolia Zeylanica, vol. 11, pt. 9, 1905, pp. 50–66.

streams, where the latter have deepened their channels by erosion, but it is more frequently below the water level, in one case as far as 120 feet. To a large extent, it underlies swamps and rice fields. The working of the available localities has been carried on so far and so long that many of them are wholly exhausted and the rest are being rapidly reduced.

The corundum appears in several varieties, and the interesting fact is noted that while the crystals before described, from the Haldummulla and neighboring localities, in connection with the sillimanite rock are prismatic, those from the gem gravels are usually bipyramidal. The varieties found are the following:

1. Korundugal—opaque and only used as an abrasive.
2. Dalam—semitransparent, inferior; sold by the pound.
3. Nila—blue sapphire.
4. Ratukete or Arunal—asteriated.
6. "Topaz,"—Oriental topaz, yellow sapphire.
7. "King topaz,"—clear pink or flesh-colored corundum.

The topaz of Ceylon is yellow sapphire; true topaz is not rare in the gravels, but it is never yellow, being either white, pale-green, or brownish-yellow. (See under Topaz.)

The methods of working the gem gravel are described in detail, and are closely similar to the native methods used in mining for rubies in Burma and for diamonds in Borneo.

The *illam* generally rests upon decomposed rock in place, called "*malawa*." In some cases the lower portions of it are cemented by iron oxide into a sort of conglomerate. In the present beds of rivers in the gem district, especially those that are fast and shallow, the actual surface gravel is gem bearing, forming a modern *illam*, doubtless largely derived from the older one, which represents the accumulation of ages.

The principal region where these gem gravels occur is the Sabaragamuwa province (Ratnapura district), and some parts of the southern province of the island.

SAPPHIRE.

MONTANA.

The sapphire workings at Yogo Gulch, Montana, are being gradually developed into a great and permanent mining industry. They have been noticed frequently in the reports of this Bureau for the last ten years, and a general statement of the disposition of the properties of the two companies engaged upon the gem-bearing dike was given in the report for 1901.[a] The English company, known as the New Mine Sapphire Syndicate, has been thus far the largest producer and the one most prominent before the public; but the other, the American Sapphire Company—frequently called the Yogo Mining Company—has been engaged in extensive prospecting and developing work, and is now preparing to begin active production on a larger scale than any heretofore attempted in Montana.

Taken as a whole, the Yogo dike is judged by qualified experts to be perhaps the greatest gem mine in the world. It extends some 4 miles in length on the surface, and being a true igneous dike, descends to an unlimited depth. If estimated down to 2,000 feet, below which possible working becomes questionable, and at an average width of only 6 feet—although it is often much wider—the entire content of sapphire-bearing rock would approximate 10,000,000 cubic yards.

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[a] Mineral Resources U. S. for 1901, U. S. Geol. Survey, 1902, p. 736.

A full report upon the whole locality, though with special reference to the American company's property, has lately been prepared by Mr. George W. Tower, jr. The area of holdings comprises a total of some 800 acres of land—300 acres under quartz-claim patent and 500 acres or more under placer patent. There are 16 patented quartz claims and 1 unpatented, and 13 patented placer claims and 1 unpatented. Some of the latter were worked for gold ten years ago, and Mr. Tower states that the first sapphire discoveries were made in cleaning up the washings of these placers. A full year elapsed before the importance of this discovery was realized, and the gems were traced to their source in the dike. Prospecting and tracing out of the dike then went on for some years, since which time (1901) there has been no further extension of the dike recognized, and no other dikes have been found in the vicinity. The main one has been quite thoroughly explored and its extent determined, as already described.

The dike runs nearly east and west and cuts almost vertically through several thousand feet of stratified rocks, horizontal or slightly inclined, from the Carboniferous down to the basal complex. In width it varies from 4 to 16 feet, and in texture it is to a large extent soft, friable, and easily weathered.

Mr. Tower's report gives details of the workings of both the companies, the English company east of the crest of Yogo Hill, and the American company west of it, to and beyond Yogo Creek. Extensive tunnels, shafts, and levels have been driven, and in the eastern portion also great open cuttings, besides a number of trial shafts and pits. Mr. Tower regards the present twofold division of working as unwise and costly, and strongly advises some form of consolidation and the concentration of work at the American company's openings at the Fourth of July claim, on Yogo Creek, the tunnels here to be made the main thoroughfare for the entire group of workings to the eastward. Here the creek yields abundant water for washing at all seasons, and the American company has run over 2,000 feet of tunnels into the dike rock, besides shafts and cuts to prove its extent. These tunnels, Mr. Tower advises, should be extended and connected with the openings eastward of the hill; thus forming one system and doing away with the expense of hoisting now involved in the English company's shafts.

The American company's work has hitherto been chiefly for development, their only output of gems being those taken out in this process. But now, the extent and richness of the property having been fully determined, they are erecting a plant for mining on the scale of 100 tons per day. This will quadruple the previous output of both companies together, and promises to make Montana sapphire mining a very important factor in American gem production.

The stones obtained are not of large size. They range from "culls," used for watch jewels and other mechanical purposes, to gems averaging, when cut, from half a carat to 2 or 3 carats and rarely up to 5 or 6. As gems they are brilliant, free from flaws, and of good color; ranging from light shades to the rich deep blue of oriental sapphires. The "culls" are produced abundantly, but not in quantities equal to the demand. They sell immediately at from $2 to $6 per ounce, and advance orders can be had without apparent limit. The Yogo crystals have an advantage for mechanical uses over East Indian stones in their form, which is largely short prismatic or rhombohedral with flat basal terminations; and hence they need much less cutting for such purposes as watch jewels and the like.

As to gems, no very full data can be given; but the shipment for the month of November, 1905, from the American company's mines to New York was 1,564 carats in the rough. These are sent for cutting to Amsterdam, and will yield from two-fifths to one-half that weight of finished stones. Their value will, of course, depend on their size and quality after being cut.

RUBY.

BURMA.

The head of the Geological Survey of India, Dr. J. H. Holland, in his recent review of the mineral production of that country from 1898 to 1903,[a] has given some additional data regarding the Burma ruby mines, which have now become an important source of profit. With regard to other locations in Burma, Doctor Holland states that leases have been granted for several ruby enterprises near Nanyaseik, in the Myitkyina district, and in the Sagyin Hills, in Mandalay district, but that little result has followed. He gives the value of the annual output since that time as follows:

Value of ruby production, Mogok district, Burma, 1898–1903.

1898	£57, 950	1901	£104, 476
1899	90, 848	1902	86, 895
1900	97, 326	1903	98, 575

Of the receipts for 1903 nearly one-half (£44,950) were profits. The falling off in the previous year was due to disastrous floods, against the recurrence of which extensive engineering precautions have been undertaken. Rubies of large size are very rare and enormously valuable. Three remarkable stones were obtained in 1899, one of which was the finest ever found since the opening of the mines to European development. This ruby weighed 77 carats and was sold for 4 lakhs of rupees, or £26,666.

EMERALD.

COLOMBIA.

The Colombian Government has recently employed a well-known expert, Mr. Lloyd-Owen, to make an examination of the condition and prospects of the great emerald mine at Muzo, northwest of Bogota. He has prepared an extended report, of which a copy was furnished to United States Minister Russell, at Bogota, for the Department of State, and an abstract was given in the United States Consular Reports for August 3, 1905.[b]

Mr. Lloyd-Owen states that the emerald-bearing area at and near Muzo is very extensive and has never been thoroughly tested or even explored. It probably covers many square leagues, the Government holdings alone being estimated at nearly 100,000 acres.

NEW SOUTH WALES.

In the recently issued guidebook published by the Colonial Government of New South Wales,[c] reference is made to the emerald locality near Emmaville, which has been occasionally reported. The region is rich in minerals, and the Emmaville and Deepwater divisions are centers of mining for tin, chiefly as stream ore, but also in the "greisen," in which wolfram and scheelite are likewise found. The location of Emmaville is about 100 miles from the coast, some 450 miles north of Sydney. Inverell, noted in connection with the New South Wales diamonds, lies to the southwest, less than 40 miles distant. The emerald

[a] Rec. Geol. Surv. India, vol. 32, pt. 1, 1905, pp. 77–78.
[b] U. S. Cons. Repts., Aug. 3, 1905, pp. 10–12.
[c] Guidebook for the Use of Prospectors in New South Wales, issued by direction of the Hon. S. W. Moore, Minister for Mines and Agriculture; Sydney, 1905, pp. 156, with map.

locality, known as "The Glen," is 9 miles north by east of Emmaville, and the guidebook states that a considerable quantity of emeralds was obtained there some years ago, but that the pegmatite dike, in which they were found, was lost or cut out at the 50-foot level. Systematic search might recover it, and there are other similar dikes in the vicinity which should also be prospected for emeralds. These dikes are offshoots from a large granitic mass intruded among claystones, which are thought to be of Carboniferous age. The dike that yielded the emeralds was a small one, varying in width from a few inches to 4 feet, and also in character from a typical "greisen" at some points to a pegmatite at the gem locality.

BERYL.

CALIFORNIA.

Mr. H. C. Gordon reports the finding of some magnificent groups of pink beryl crystals, measuring 1½ inches in diameter, of the flat type of crystal, rich pink in color, but attached to albite rock, in the Esmeralda mine, Mesa Grande, San Diego County, Cal.

NORTH CAROLINA.

Mining for beryl has been carried on more or less extensively in North Carolina, but without much result. It was found, however, in the Spruce Pine region that by deeper mining blue beryls were frequently obtained at a greater depth than any previously taken out, and in some quantity. Many gems have been obtained weighing from three-fourths of a carat to 2 carats each, but few are over 4 carats in weight.

TOPAZ.

CALIFORNIA.

The white and blue topazes from the Ramona district, San Diego County, Cal., described in the report of this Bureau for 1904,[a] were well represented in the gem exhibit of San Diego County at the Lewis and Clark Exposition, at Portland, Oreg., in 1905. Large specimens of the associated minerals—albite, orthoclase, garnet, tourmaline, etc.—were displayed, showing the topaz in its natural environment, and then as separate crystals and as cut gems.

AUSTRALIA.

Mr. C. Anderson, mineralogist of the Geological Survey of New South Wales, gives some further accounts of the topaz occurrences in that colony and also in Tasmania,[b] described by him in the previous volume of the Records and noticed in the report of this Bureau for 1904. The article is mainly crystallographic, describing and illustrating some particularly fine examples recently obtained from the several localities before reported. No additional facts of any importance are given concerning the mode of occurrence, as previously described, at Emmaville and Oban, in New South Wales, and at Mount Cameron, Flinders Island, and Bell Mount, Tasmania, save the mention of the existence of pale pink and yellow varieties in Tasmania, which had been reported as not found there. Some of the crystals from Flinders Island, Killicrankie Bay, are of remarkable size, up to several inches in diameter.

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[a] Mineral Resources U. S. for 1904, U. S. Geol. Survey, 1905, pp. 979–982.
[b] Rec. Austral. Museum, vol. 6, pt. 2, Sept. 15, 1905, pp. 83–89.

BRAZIL.

A recent letter to the writer from Mr. H. Kilburn Scott, a mining engineer residing at Rio de Janeiro, gives some interesting notes on topaz mining at the Ouro Preto locality, in the State of Minas Geraes. The principal mine—the Boa Vista—has been worked for some years past by a firm employing about twenty men. The method has been to excavate to some depth the overburden formed by slides and the caving of the decomposed inclosing rock and then to run small inclined shafts to reach the topaz-bearing deposit. There has thus been formed a great craterlike excavation, in which the clay carrying the topazes has been followed down some meters below the drainage level. Hence it is possible to work the mine only during the dry season, and with the present method the limit of working has probably been reached. To operate this mine successfully improved methods will be necessary.

CEYLON.

Among the precious stones gathered from the widely distributed gem gravel of Ceylon, topaz is fairly abundant, but the bright yellow variety is absent. What is spoken of as topaz among Ceylon gems is the rarer and harder oriental topaz, or yellow sapphire. The name of "king topaz" is also applied to pink or flesh-colored sapphire. The true topazes of the gravel are either colorless or light green, occasionally also pinkish-yellow or yellow-brown. The first variety is cut and sold under the name of water-sapphire, which belongs properly to iolite (cordierite); the name is entirely misapplied, as the true water-sapphire is blue. The green topazes are sold, with true beryls, as aquamarines. The pinkish-yellow stones closely resemble those from Brazil, but with the curious difference that while the latter turn to a clear pink on being heated (the so-called burnt topaz), the Ceylon stones are absolutely decolorized by heat. The source of the gems is not known, as they are obtained only from the gravel, but it must evidently be in the granite intrusives of the Balangoda group.[a]

ZIRCON.

CEYLON.[b]

A large variety of zircons are found in the gem gravels of the island of Ceylon, with many other precious stones which are a good deal confounded among native dealers and classified largely by color. The Cingalese name *toramalli* is applied indifferently to both tourmaline proper and zircon, and special terms are prefixed according to the color. The green variety is mostly zircon, with some tourmaline and chrysoberyl. The pale brown also includes some tourmaline. Other varieties of zircon found are rich yellow and fiery red. The readiness with which zircon alters in color by heat is illustrated in the fact that many greenish stones become a fine yellow by heating, and that the pale brown ones are often completely decolorized in the same manner to form the so-called Matara diamonds.

NEW SOUTH WALES.

A paper was read several years ago by Mr. D. A. Porter before the Royal Society of New South Wales on the occurrence of zircon in the New England

[a] Mineralog. Surv., Ceylon; 1904.
[b] Ceylon Administration Repts., 1904; Mineralog. Survey.

district of that colony. In a recent article by Mr. C. Anderson, mineralogist to the Australian Museum, this paper is cited and some fresh specimens received from Mr. Porter are described in detail.[a]

The principal localities are at Glen Innes and Inverell, places about 30 miles apart. Mr. Porter describes the zircons as found over a considerable area of basaltic country on the northern watershed of the MacIntire River. They occur in stream beds and in raised banks of clay or gravel along the streams or strewn over the surface of low sloping ridges. The specimens are generally broken and cleaved and much worn, but some good crystals occur, varying from clear colorless to dark red.

TASMANIA.

R. Brauns gives [b] the measurement of the crystals of zircon from Tasmania showing that crystallograpically they very strongly resemble those from Russia. Generally, however, the crystals are very large and rolled; others are entirely rounded. These have been extensively imported at Idar and Oberstein. Many of them are colorless and become violet-brown in color by heating. Others are made entirely colorless by the same process.

GARNET.

OREGON.

Mr. L. Bush Livermore, of Baker City, Oreg., describes a deposit of garnets in the Sutton Creek district, some miles south of Baker City, which he regards as worthy of investigation.[c] He says that near Pleasant Valley, where the principal rock appears to be a black argillite, soft and crushed and with no well-marked planes of bedding, has been found a strong ledge containing garnets resembling rhodolite. Some of these are quite handsome and lustrous, and large enough to cut gems up to 30 carats in weight. Further particulars of this occurrence are quite desirable. Nothing has yet been done to develop it.

ESSONITE.

CALIFORNIA.

A curious occurrence of garnet is reported by Mr. F. M. Sickler, as noted by himself and Mr. George Frey at a point some 7 miles from Pala, San Diego County, but not otherwise specified. The association here was of the Ramona type—essonite garnet with beryl, the former varying from light yellow to ruby-color. The garnets occur in rounded pieces like pebbles or nodules. These were found to be, apparently, remnants or cores of larger crystals that had decomposed, leaving their original form as casts in the feldspar matrix. Besides the garnet cores these cavities contained mica and red clay, doubtless products of alteration from the garnet crystals that have partly disappeared.

A fine display of garnets of various shades, chiefly from the Ramona district, was made in the San Diego County exhibit of gem minerals at the Lewis and Clark Exposition at Portland, Oreg., in 1905.

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[a] Rec. Austral. Museum, vol. 6, pt. 2, Sept., 1905, pp. 95–96.
[b] Separat-Abdruck aus dem Centralbl. für Mineralogie, 1905, pp. 483–485.
[c] Mining Record, July 29, 1905.

PYROPE.

NEW YORK CITY.

An interesting discovery of pyrope garnet has been made in constructing the rapid transit tunnel from the south end of Manhattan Island to Brooklyn. This tunnel runs from the Battery at the foot of Whitehall street to the foot of Joralemon street, Brooklyn. About 1,000 feet south from the New York starting point, beautiful grains or nodules of pyrope were obtained, capable of being cut into gems of three-fourths of a carat to 1 carat in weight. These were in connection with serpentine, of which the writer found many pieces on examining the dumps—some of it of the green precious variety—together with kerolite, but he did not succeed in obtaining any that actually contained pyrope.

Pyrope is a mineral belonging to igneous rocks, especially peridotites, from the alteration of which serpentine is frequently formed. The serpentines of New York and vicinity are now quite clearly shown to have originated in this way.[a]

TOURMALINE.

CALIFORNIA.

The colored tourmalines of the Pala district, in San Diego County, Cal., were finely shown in the mineral exhibit of that county at the Lewis and Clark Exposition, at Portland, Oreg., in 1905. The principal displays were of rich, deep-red rubellite, from the Pala Chief mine, and of various colored tourmalines, though mainly pink rubellite, from the San Diego Company, of Mesa Grande. All these were shown in fine specimens, both in crystals and in cut form.

CONNECTICUT.

Information has been received from Mr. S. Ward Loper, of Middletown, Conn., that a new locality for colored tourmaline has been opened in the northeast corner of Portland, Conn., at what is called the Strickland quarry. Besides one very large crystal of deep green color, several fine and clear specimens have been found—all green; no pink ones as yet. This locality is but a few miles from the celebrated one at Haddam Neck.

MAINE.

The year 1905 was not very productive in gem tourmalines from Maine. Considerable mining was carried on for feldspar and mica, and some for lepidolite, but the yield in gem tourmaline was scanty. A letter from Mr. Loren B. Merrill, of Paris, Me., describes his own work at Mount Mica and gives the general facts as to the other localities. The quarries at Auburn have yielded practically no gem material. At Newry a good deal of tourmaline has been found, some of the crystals very large, up to 4 inches in diameter; but at that place the crystals are not in pockets, but traverse the pegmatite in the manner of beryls, and hence are liable to much breakage. At this locality pink tourmaline predominates over green. Mr. Merrill has found numerous pockets at Mount Mica, with much cookeite and quartz crystals, but the tourmalines are mostly small and of pale (green) color. One such pocket was notable for its great size, being 8 feet long by 5 feet wide and 3½ feet deep.

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[a] Newland, D. H., The Serpentines of Manhattan Island and vicinity: School of Mines Quart., April, 1901, pp. 399-410.

JADEITE.

BURMA.

Jade, so highly valued in China, has long been known to occur in Burma, and much of that employed by the Chinese has been thence obtained. The latest accounts of it are given in the Review of Mineral Production in India for the years 1898 to 1903, by Dr. J. H. Holland, Director of the Indian Geological Survey.[a] The industry is quite extensive, being second only to the ruby mines in the gem-stone production of India. Jade has usually been obtained from bowlders, etc., but in upper Burma it is found in place and is systematically quarried. The locality is in the Mogoung division of the Myitkyina district, near Tammaw, where the jade forms a light-colored layer in a dark-green serpentine, which is apparently intrusive in sandstones of Miocene age. Doctor Holland thinks that the jade "must have been separated as a primary segregation from the magma," whence the serpentine was derived.

Some fine material is also obtained from rolled pieces in the valley of the Uru River, an affluent of the Chindwin.

The product is taken into China, partly overland and partly via Rangoon, and thence to the Straits Settlements and China. The trade is quite important, and averaged annually from 1897 to 1903, inclusive, 3,914 hundredweights, valued at £44,770, an average price per hundredweight of £11.44.

All the Indian jade is jadeite, the soda-alumina variety, related to pyroxene. The other variety, nephrite, a lime-magnesia member of the amphibole group, is not known in India at all, or at least of any valuable quality.

KUNZITE, BERYL, TOURMALINE.

CALIFORNIA.

In the report of this Bureau for 1903 [b] a list was given of mines and prospects on Hiriart Mountain, to the east of the Pala and Pala Chief ridges, in which the gem minerals of the district—colored tourmalines, kunzite, beryl, and their associates—were to some extent observed. In the general outline of California gem mines, contained in the report for 1904 [c] an account was given of later developments at one of these mines—the Naylor-Vanderberg. Recent information describes quite active work, with promising results, as having been carried on during 1905 at several of these openings. It is highly interesting to find there are now a number of adjacent localities yielding good indications of the minerals that have already made the Pala region so notable in American gem production, particularly of pink beryl and kunzite, as well as of tourmaline and garnet.

The Naylor-Vanderberg mine already noted has been penetrated by a tunnel nearly 200 feet long, which cuts the main vein in the two mines. This has revealed lithium beryl, kunzite, and a transparent green spodumene, suggesting that found years ago in North Carolina. A rare ferro-manganic phosphate of purple color also occurs here.

The Hiriart mine has been opened by a tunnel for 80 feet; the ledge here consists largely of albite with disseminated lepidolite. Tourmaline was found and some lithium beryl, but no kunzite. The tourmalines were deep grass green, aquamarine blue, and sometimes green with a pink or a black center.

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[a] Rec. Geol. Survey India, vol. 32, pt. 1, 1905, pp. 53–54.
[b] Mineral Resources U. S. for 1903, U. S. Geol. Survey, 1904, p. 942.
[c] Mineral Resources U. S. for 1904, U. S. Geol. Survey, 1905, p. 972.

The White Queen mine (at which the original discovery of kunzite was made in 1902) has been further opened by a cut in the main ledge, which revealed lepidolite and gem pockets. Salmon-pink lithium beryls were the principal gems found, some being very fine specimens. Gem tourmaline was also encountered to some extent, but nothing is reported of kunzite.

In the Catarina mine a large open cut has been made, and good material was shown. The "pay streak," or central gem-bearing zone of the ledge, varies from 2 to 4 feet in thickness and consists of quartz, albite, and lepidolite. Several pockets were found, containing chiefly quartz crystals and violet-colored kunzite. Another opening, one hundred yards to the east, revealed similar pockets, with pink kunzite and some indicolite, together with quartz crystals, often clear and fine. One pocket yielded nearly a ton of crystallized quartz, some individual crystals weighing as much as 40 pounds.

The Anita mine was tested by several cuts and yielded quartz crystals, lepidolite, and good pink kunzite.

The Sempe mine was opened on two ledges, and fine pink beryl was taken from one and white beryl from the other.

The San Pedro mine is traversed by the same dike or vein as the Catarina and the Naylor-Vanderberg. In this a large open cut showed pink beryl, pink kunzite, green tourmaline, and fine quartz crystals.

A fine display of kunzite, both in the natural state and in cut forms, was made in the mineral cases of the San Diego County exhibit at the Lewis and Clark Exposition at Portland, Oreg. These came from the mine on Pala Chief Mountain, and included large, well-colored crystals and fine, violet-tinted cut stones, one weighing 150 carats and another 80 carats, besides other cut kunzites mounted in jewelry, with pearls, etc.

QUARTZ.

TEXAS.

Beautiful, small crystals from 2 to 3 mm. in diameter, doubly terminated and of absolute purity, resembling those from Herkimer County, N. Y., have been found near Mullen, Mills County, Tex., by Mrs. Ellen Oxley.

ROSE QUARTZ.

COLORADO.

A magnificent vein of rose quartz has been located by Mr. W. C. Hart, of Manitou, Colo., 25 miles west of Fort Collins, in Larimer County, Colo. The quartz vein crosses the road between Stove Prairie and Box Prairie at an altitude of 8,000 feet. The country rock is granite, with quartz veins running through the granite. Pieces weighing from 1 to 1,000 pounds could be taken out. There is a large body of the quartz, the vein in places being 3 feet thick. Some 21,000 pounds were taken out during 1905.

AMETHYST.

NORTH CAROLINA.

From time to time amethysts are brought in from localities in North Carolina, and especially from the region of Rabun Gap, Georgia, on the North Carolina border, although no quantity seems to exist to warrant mining at present. Yet many of the stones afford such rich brilliant gems that at no foreign locality have choicer gems been found.

QUARTZ GLASS.

Quartz fused for chemical ware.—Attempts have been made to manufacture articles for chemical use from quartz glass, and it seems that this result has been lately attained. Three chemists in Germany—Herceus, Siebert, and Kuhn—have succeeded in blowing flasks of ordinary laboratory sizes from fused quartz. The mineral is melted in crucibles of iridium or iridium-ruthenium by the oxyhydrogen flame in a furnace of lime or magnesia. The difficulty in previous attempts has been that the quartz glass produced was full of bubbles. But these escape if the quartz is kept in fusion for some time, and this can be done in a crucible of iridium which will sustain a temperature of 2,200° C., as quartz requires for the vitreous modification only about 1,700° C. The operation of blowing the quartz glass is one of extreme delicacy. The vessels produced are almost completely unaffected by acids or salts, but naturally are attacked by alkaline solutions.

NONCRYSTALLINE QUARTZ.

AGATE.

INDIA.

Agate is obtained in considerable quantities in India and is exported both to Europe and to China, as well as worked at some points by native lapidaries. Its source is in the amygdaloidal portions of the Deccan trap flows, and it is collected at numerous places along or near the edge of the trap, especially in the State of Rajpipla, from a conglomerate near a village named Ratanpur. The principal place where it is sold and cut is Cambay, in the Bombay Presidency, though agate cutting is also done at Jabalpur and some other points. Data as to quantities and values are not readily obtainable.[a]

MOSS AGATE.

WYOMING.

An extensive demand for the moss agate found in Hartville district, Wyoming, is reported, a single party having taken out 4½ tons of this material, which was sold in Germany at an average price of $200 per ton.

JASPER.

CALIFORNIA.

An outcropping of jasper 2 feet wide has been uncovered in the brushy country near Dulzura, San Diego County, Cal.[b] The rock is ribbed in different directions with red and yellow streaks combined with a soft gray. It is claimed that it polishes beautifully, and that the brilliant colors blend most delightfully when polished.

TEXAS.

A remarkably interesting occurrence of jasper has been discovered 20 miles north of Brackettville, Kinney County, Tex., as an outcrop on the mountain

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[a] Geol. Surv. India, vol. 32, pt. 1, 1905, p. 107.
[b] Los Angeles Min. Review, Dec. 23, 1905.

side. The jasper occurs in bands of brown and white, yellow and white, and red and white, strikingly resembling that of Trego County, Kans.

OPAL.

OREGON.

In the last report of this Bureau[a] a reference was made to specimens of opal obtained some years ago from Oregon. What seems probably to be this same occurrence is spoken of by Mr. L. Bush Livermore, of Baker City, Oreg., in an article in the Mining Record[b] of July 29, 1905, on the precious stones of that State. The section that he describes is that known as the Burnt River region, an area of some 800 square miles a little south of Baker City. A few miles below the town of Durkee a creek flowing from the slopes of Lookout Mountain cuts through a series of bedded tufas. Here have been found opal-containing cavities in a rhyolitic tufa, the opals somewhat abundant and quite handsome, but frequently with a bluish tint and not very brilliant. A quarry has been opened to test both quantity and quality.

NEW SOUTH WALES.

The opal deposits of New South Wales have been described again in a handbook for miners and prospectors, issued under the direction of the minister of mines and agriculture of that colony, Hon. S. W. Moore, M. P.[c] These interesting and important opal mines have been treated of quite fully in the reports of this Bureau, together with those of Queensland,[d] which are continuous with them and geologically identical. So far as description is concerned little is added in this recent volume, but the extent of the opaliferous area is shown to be wider than heretofore announced. A new region is described much farther east than any previously known, at Wallangulla, in the county of Finch, situated in the Walgett division, about 50 miles north of the town of Walgett, half way to the Queensland border. The rock here is an outlier of the Desert Sandstone (Upper Cretaceous), and the conditions are identical with those in the White Cliffs region, which lies some 300 miles away, in a direction south of west.

The opal from Wallangulla is described as of fine, deep color, and a good deal of it is of the highly prized mosaic or "harlequin" variety. No large quantity has yet been taken out, however, and the field needs to be developed. It is judged that there may be many other good localities in this region, between Walgett and the Queensland border, but the country is remote and difficult of access, and those now at work find it hardly possible to make their expenses under present conditions.

The output from the White Cliffs district since 1890 has been very large, reaching, to the end of 1904, a total estimated value of £873,599, or about $4,250,000. It has increased in the last decade quite irregularly but largely, although in 1904 it fell off seriously. This is attributed to a difficulty in obtaining first-class material, while the lower grades have been produced in excess and have fallen greatly in price.

WEST AUSTRALIA.

The occurrence and the peculiarities of crocidolite opal in West Australia have been noted in the reports of this Bureau for the last three years. In the

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[a] Mineral Resources U. S. for 1904, U. S. Geol. Survey, 1905, p. 956.
[b] Mining Record, July 29, 1905.
[c] Guidebook for the Use of Prospectors in New South Wales; Sydney, New South Wales, 1905, pp. 33–34, 42–43.
[d] Mineral Resources U. S. for 1902, U. S. Geol. Survey, 1904, pp. 854–856.

annual report of the Geological Survey of West Australia for 1904[a] the existence of a precious opal at Coolgardie is described by the government geologist, Mr. A. Gibb Maitland. His assistant, Mr. C. F. V. Jackson, was sent to the locality to collect and report. The conditions are peculiar, the opal occurring in a seam or belt of dark, compact, slaty rock, thought to be a metamorphosed phase of the schists and amphibolites of the district. The rock is full of joints and partings, infiltrated with silica, which occupies small fissures and cavities, both as quartz and as opal. The latter is chiefly of the common variety, but is sometimes precious and of fine quality. The veinlets are so small that little opal can be found suitable for cutting, yet in places the cracks filled with opal form such a network that the whole might be worked as a beautiful "matrix" stone. Mr. Maitland feels doubtful as to the prospect of this locality being profitable on any large or permanent scale.

OPAL PSEUDOMORPHS.

NEW SOUTH WALES.

In the White Cliffs opal district of New South Wales there occur many pseudomorphous forms of opal after shells, crinoids, saurian bones, and coniferous wood, and there are also curious masses of grouped crystals, known locally as "fossil pineapples," representing the replacement of some mineral not clearly determined.[b] A paper has lately appeared in regard to these problematic bodies, by Messrs. C. Anderson and H. Stanley Jevons,[c] in which they present the results of a very careful study of some of the best specimens obtained, and, after reviewing and dissenting from the suggestions of previous writers (see Mineral Resources for 1901), are led to believe that the original mineral must have been glauberite.

TURQUOISE.

CALIFORNIA.

In the last report of this Bureau, in the special section devoted to the gem minerals of California, the turquoise mines in the desert region of San Bernardino County were described.[d] It was there stated that these mines had produced a large amount of material, including some stones of unusual size, but that nothing had been done in 1904. Since then considerable quantities of material have been taken out, including many stones of large size, which range from 50 to several hundred carats. Some of the latter have sold as high as $1,500 each. The color is mostly a pale shade, but it has seemed to be popular, and large quantities have been sold in the form of beads for necklaces, etc., either of uniform size or graduated.

PERSIA.

The old turquoise mines near Meshed, in eastern Persia, are still producing quite extensively, notwithstanding the rude methods employed in working them and the competition of the American mines. The registered exports for last year had a value of £9,396, which may represent one-fourth of the total output, as there is a continuous local demand and also probably considerable smuggling. Every Persian must possess a turquoise, good, bad, or indifferent, and fine stones

[a] Ann. Prog. Rept. West Australia, 1904, pp. 19–21.
[b] Mineral Resources U. S. for 1901, U. S. Geol. Survey, 1902, p. 759.
[c] Rec. Austral. Museum, vol. 6, pt. 1, June, 1905, pp. 31–37.
[d] Mineral Resources U. S. for 1904, U. S. Geol. Survey, 1905, p. 966.

command higher prices there than in London, but inferior grades are lower. Large pale turquoises often veined or spotted with white, are exported a good deal to India and sold there quite cheaply. The mines are farmed out by the local authorities for a yearly payment of £5,000, and the lessees in turn rent most of them to other parties.

VESUVIANITE (CALIFORNITE).

CALIFORNIA.

In Bulletin No. 262 of the United States Geological Survey[a] Prof. F. W. Clarke and Mr. George Steiger have given full analyses of the compact variety of vesuvianite, called by the writer californite, from Siskiyou and Fresno counties, Cal., and also of the peculiar white garnet found associated with it at the latter locality.[b] The analyses are recalculated and reduced to a uniform type by eliminating impurities and replacements, and an attempt is made to deduce structural formulas. The white mineral proves to be a true garnet, containing as an impurity about one per cent of calcium carbonate. The variations in these and many other analyses of vesuvianite lead Professor Clarke to the view that this mineral may be a mixture of several closely related molecules. These Californian varieties, and others also, conform very well to the expression

$$Al_2\,Ca_7\,(SiO_4)_6\,(Al\,O\,H)_2.$$

This differs slightly from the formula previously deduced by Dr. Clarke, viz:

$$Al_2\,Ca_6\,(Si\,O_4)_5\,Al\,O\,H,$$

which serves well "for the average composition of the species, but does not fit the extremes." Hence the suggestion of a mixed constitution.

Vesuvianite should be considered as a basic orthosilicate belonging to a group of which garnet is the normal type, with epidote and the scapolites as other members. Their formulas are closely related; they originate similarly from contact metamorphism. They all alter in much the same manner, and yield similar or even identical derivatives.

OBSIDIAN.

MEXICO.

In the report of this Bureau for 1900 was given an account of the great prehistoric obsidian mines in Mexico, near Pachuca, in the State of Hidalgo, as visited and described by Prof. W. H. Holmes. At this point, though the material exists in such quantity, yet no outcrops could be seen, all being buried under the heaps of débris and fragments left by the ancient workers. A recent communication to the author from Mr. J. M. Hamilton, of Tequisquiapan, in the State of Queretaro, describes another locality some 60 or 70 miles west of the former, where a closely similar obsidian occurs abundantly, but does not appear to have ever been mined or developed, and where the outcrops are entirely accessible. The locality is near the border of the States of Queretaro and Hidalgo, on a range of low hills east of the San Juan River, between the crossing of that stream by the Mexican Central Railroad, at San Juan del Rio, and by the National Railroad of Mexico a few miles below.

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[a] Contrib. to Mineralogy: Bull. U. S. Geol. Survey No. 262, 1905, pp. 72–74.
[b] Mineral resources for 1901, U. S. Geol. Survey, 1902, p. 747; Am. Jour. Sci., 4th ser., vol. 16, 1903, p. 397.

Mr. Hamilton describes the obsidian as occurring in parallel "veins" from 6 inches to 2 feet in width, but gives no particulars as to their position or direction. The colors are black, opalescent, and green with dark bands, also a lighter green without banding. He has had specimens polished for sleeve buttons and like purposes, and it appears to be capable of ornamental use and to be procurable in abundance, as Mr. Hamilton states that it can be picked up by wagonloads at the outcrop.

UTAHLITE (VARISCITE).

UTAH.

A very interesting discovery has lately been announced of a new occurrence of this attractive and wholly American gem stone, hitherto obtained from only one locality—at Mercur, Tooele County, Utah—first made known in 1894 and described in the report for that year.[a] The new occurrence is also in Utah, and the particulars regarding it are furnished by Mr. Edward Bird, of Salt Lake City. The location is about 20 miles northwest of the other one, and lies 8 or 9 miles west of Stockton and some 40 miles southwest of Salt Lake City. The mineral appears in a ledge which crosses a little spur or foothill running eastwardly from the main range of the Stansbury Mountains. This hill is some 1,500 feet long from east to west, and rises to a maximum height of 200 feet above the adjacent "bench lands." The variscite occurs in two seams or ledges which traverse this foothill in a northerly and southerly course, dipping steeply westward. The only development thus far done is an open cut on the south side of the foothill or spur, some 10 feet long and 4 feet deep. The surface rock appears to be an iron-stained brecciated quartz. At the west end of the hill, where a little depression separates it from the main Stansbury range, there is an outcrop of brownish laminated quartzite; at the east end appears a strong body of bluish limestone. No metallic veins have been observed in the vicinity.

The variscite itself occurs in the same manner here as at the Mercur locality, in roundish or kidney-shaped nodular masses from the size of a lemon to that of a large cocoanut, with a rough external coating or casing of reddish-brown color, inclosing the beautiful green material within. Mr. Bird observes that this color tends to become deeper in the lower part of the cutting, suggesting an increase of richness with depth; but this point has not yet been established. He also thinks that slabs can be cut from the compact rock, showing the variscite contrasting with the reddish-brown quartzose matrix. Little has yet been regularly taken out, but enough to show the fine color of the green interior, and a number of persons have had charms and ring stones cut from it.

PSEUDO-SERPENTINE.

WASHINGTON.

In a report of this Bureau a description has been given of a very handsome serpentine from the State of Washington, exhibited at the Buffalo and Charleston expositions. A recent article by Prof. F. W. Clarke[b] gives an account of some remarkable peculiarities in this mineral, which lead him to designate it as a "pseudo-serpentine." Analysis shows that it contains a large proportion of (apparently) brucite, intimately mixed with some serpentine, and also a

[a] Sixteenth Ann. Rept. U. S. Geol. Survey, pt. 4, 1894, p. 602.
[b] Clarke, F. W., Contrib. to Mineralogy: Bull. U. S. Geol. Survey No. 262, 1905, pp. 69–71.

chloritic mineral judged to be clinochlore. Numerous tests and experiments are described looking toward exact determination of the mingled components, though the precise distinction of them is very difficult. Professor Clarke says: "The rock is unusual in character; and if the sample examined is fairly characteristic of the entire deposit, the latter should be carefully studied in reference to its origin and its geological relations."

AMBER.

TEXAS.

A yellow, resin-like amber is common in the Cretaceous coals at Eagle Pass and on Terlingua Creek, as is reported by Prof. J. A. Udden. The largest pieces are of the size of a grain of corn, and small pieces can always be easily found.

SANTO DOMINGO.

Mr. Clarence C. Sample, in an account of the occurrence and production of amber in Santo Domingo,[a] states that the locality is identical with that described by Mr. C. W. Kempton in the report of this Bureau for 1903,[b] but it would appear that much progress has been made in the past two years in the matter of production. The hill on the upper Licey River, the locality of occurrence, is one of the foothills of the Monte Cristi Range, which flanks the north coast eastward to Samana, and forms the northern limit of the Vega Real of Columbus, the great central valley plain. The rocks of the Monte Cristi Range are chiefly sandstones and shales, with some conglomerate, and are rather soft and much eroded. Amber is found in them at several points, but the principal district is that of Tamboril, in a region comprising some 50 square kilometers, a few miles north of Santiago.

Many of the beds of shale and sandstone contain carbonaceous matter and some carry lignite, and it is in these that the amber is found, but unfortunately no fossils have been obtained to fix the exact age. Mr. Sample states that the quantity of amber found is only a fraction of a pound to a cubic yard of rock, so that when the latter is at all hard there is not enough amber to render working profitable, as any process of rock crushing would involve breaking up and damaging the amber. It occurs in pieces varying from small sizes up to several pounds, and in color from light yellow to deep red, with also a black variety of little value. The curious fact is noted that the red amber can be bleached by a few hours' exposure to the sun.

BURMA.

Burmite (*Burmese amber*).—Amber has long been known as obtained in Upper Burma, and the recently published "Review of the Mineral Production of India from 1898 to 1903," by Dr. T. H. Holland, Director of the Geological Survey of India,[c] gives some interesting facts regarding its occurrence and production. The quantity and value have varied extremely, but during the years mentioned the annual output has averaged 51 hundredweights, valued at £362. The amber is mined principally in the Myitkyina district, in the Hukong Valley. It occurs in clays, judged to be Miocene, and has also been recognized in similar strata of that age at a few other Burman localities. The product is mostly taken to Mandalay, where it is worked into beads, ear cylinders, and

[a] Eng. and Min. Jour., August 12, 1905.
[b] Mineral Resources U. S. for 1903, U. S. Geol. Survey, 1904, p. 964.
[c] Rec. Geol. Surv. India, vol. 32, pt. 1, 1905, pp. 95–97.

other ornaments for native use. Of late it has been undersold even there by cheap Prussian amber, and the semiartificial ambroid, made from chips and fragments. The supply seems to be quite considerable, although the larger pieces are frequently opaque or discolored, and are injured by cracks filled with calcite. It is hard and very tough, and is thus well fitted for carving and turning. Like that of Sicily, it is often fluorescent.

The name burmite has been given to this amber by Otto Helm as a distinct species from true amber or succinite, in that it contains absolutely no succinic acid. Its analysis is as follows:

Analysis of burmite or Burmese amber.

Carbon	80.05
Hydrogen	11.50
Oxygen	8.43
Sulphur	.02
	100.00

CHRYSOCOLLA.

CALIFORNIA.

Mr. William V. Holley, of Los Angeles, Cal., gives an account of a combination of richly colored copper minerals found at Cima, in San Bernardino County. Chrysocolla, azurite, and malachite are here mingled in compact size, so that the whole may be cut and polished, showing various shades and patterns of blue and green in beautiful manner well adapted to use in ornamental work.

DUMORTIERITE.

The rare blue mineral identified in 1879 by Gonnard and named by him dumortierite, has lately been found at two new localities on the Pacific coast, and is made the subject of an extended discussion by Mr. W. T. Schaller, in Bulletin No. 262 of the United States Geological Survey.[a] In the report of this Bureau for 1892 the announcement was made of the notable occurrence of dumortierite at Clip, Yuma County, Ariz., where it so fills masses of quartz as to resemble lapis-lazuli, and reference was also made to another locality in Riverside County, Cal., where it occurs in the same way, as fibers penetrating and coloring quartz. This was more fully described in the report of 1893, but nothing seems to have been heard since then of this latter occurrence.

California.—Within a year or two past dumortierite has been found in larger quantity and of a different tint in San Diego County, Cal., a few miles east of Dehesa, the place noted for its "orbicular diorite." Here it appears in masses of several centimeters in either direction, with a radiating columnar structure and of a pinkish lavender color, instead of its usual indigo blue. It occurs intermingled with quartz in the lower half of a large dike, the upper half of which contains sillimanite, instead of dumortierite, similarly associated with quartz.

Washington.—Another locality lately announced is in Skamania County, Wash., at the headwaters of the North Fork of Washougal River. Here the form is different again, the mineral being present in minute spherulites composed of radiating fibers of strong blue color. These are distributed through a fine-grained quartz matrix as blue specks, sometimes massed in patches and sometimes abundant enough to color the whole mass. Associated with it is andalusite, apparently taking the place of the closely related species sillimanite at the previous locality.

[a] Contrib. to Mineralogy: Bull. U. S. Geol. Survey No. 262, 1905, pp. 91–120.

Arizona.—At Clip, Ariz., the associated mineral is kyanite; so that these three species, so nearly allied in composition, appear to have close relation with the dumortierite, one or other of the group being in every case associated. The bearing of this fact will be noted presently. Muscovite, also in small quantities and apparently a product of alteration, is present at each of these three western localities. At the New York occurrence, in Harlem, the dumortierite appears in a vein of coarse red pegmatite, and is generally in the feldspar, associated with black tourmaline, muscovite, and small quantities of some other minerals. The French localities near Lyons present a similar mode of occurrence. At a few points in Bohemia and Silesia it is also known, and appears to belong in a pegmatite.

Mr. Schaller's paper goes into a very careful examination to determine the exact composition of this species and its proper place among the silicates. The analysis brings out very clearly the true constitution of dumortierite as a member of the kyanite-sillimanite-andalusite group, differing from andalusite only in a small content of boron.

The average of the two analyses of Dehesa material is as follows:

Average of two analyses of dumortierite from Dehesa, Cal.

SiO_2	28.68
Al_2O_3	63.31
Ti_2O_3	1.45
Fe_2O_3	0.23
H_2O	1.52
B_2O_3	5.37
	100.56

in which the titanium and iron are regarded as replacing alumina. Grouped together, the ratios for silica, alumina, boric acid, and water are almost exactly 6 : 8 : 1 : 1, and yield the formula:

$$8\ Al_2O_3\ 1\ B_2O_3,\ 1\ H_2O,\ 6\ SiO_2,$$

which may be written—

$$(SiO_4)_3\ Al\ (AlO)_7\ (BO)\ H.$$

This, when written graphically, is extremely close to the expression for andalusite, the radical BO, with a hydrogen atom, replacing a part of the alumina. The alteration of dumortierite to muscovite is also shown very readily, alumina and boric acid being set free and potash taken up.

As to the physical properties of dumortierite, the crystallization is orthorhombic, though there is little material to judge precisely upon, the mineral being usually fibrous. The density averages 3.3. Pleochroism is marked and varies in specimens from different localities, being colorless (or rarely pale yellow) to cobalt blue, pistachio green, rose salmon, carmine or red-purple—the latter is found only in the California specimens, and is regarded by Mr. Schaller as due to the titanium present.

LEPIDOLITE.

In the eighteenth century lepidolite was used as a pleasing ornamental stone, polished and cut into such objects as are fluorite and malachite.

In a series of mineralogical notes in Bulletin No. 262 of the United States Geological Survey, Mr. W. T. Schaller describes some features of the crystallization of lepidolite.[a] He has examined a number of crystals from the vicinity

[a] Schaller, W. T., Contrib. to Mineralogy: Bull. U. S. Geol. Survey No. 262, 1905, pp. 139–143.

of Ramona, San Diego County, Cal., and gives a series of observations thereon, which he states are to be more fully presented in a forthcoming paper on the lithia minerals of California. He finds in general a very close relation to muscovite, with certain differences, however, in three respects, viz: That in lepidolite twinning is very rare, the characteristic M face of muscovite (221) is wanting and the *a* face (100) unusual in muscovite, is frequent.

He also describes a mode of occurrence in lepidolite from Mount Mica, Maine, which has very rarely been previously reported. This is the globular aggregation of crystals, which is not infrequent in muscovite. It has been barely mentioned by von Rath, from Elba, and by Doctor Hamlin, from Mount Mica. Mr. Schaller reports it as occurring both at Mount Mica and at Mount Apatite, on Pulsifer's Ledge in Auburn, Me. At both these localities the spheroidal groups attain a size of several centimeters in diameter.

MISCELLANEOUS.

Gem minerals at the Portland Exposition.—The products and resources of the Pacific States were illustrated on a large scale at the Lewis and Clark Exposition held at Portland, Oreg., in 1905. Among these the mineral exhibits were very conspicuous, and the Palace of Mines impressed every visitor. A marked feature in this building was the collection of precious, semiprecious, and ornamental stones of the Pacific coast and adjacent States, which the writer was appointed to prepare. It included representatives of all the more remarkable gem minerals from the entire Pacific coast region and from many points of the interior Northwest, together with some from Arizona and Utah. Most of these have already been described in the reports of this Bureau.

From the Pacific coast proper the most northerly exhibit was that of large crystals of garnet from Fort Wrangell, Alaska. From Prince of Wales Island were shown magnificent large crystals of dark-green epidote, found by accident in mining for copper. Of special interest are the aboriginal celts, hammers, and knives made of green jade, found in graves in Alaska. Lieutenant Storey, U. S. Navy, succeeded some years ago in finding this substance in place as a vein material at a point known as Jade Mountain. Thus was disproved the hotly contested theory that jade existed only in Asia, and hence that all the material, whether found in ancient Roman graves, in France, in the Swiss lakes, or in America, must have been brought by migration or by trade from that continent.

Fine agates were shown from Oregon.

A mineral exhibited and closely similar in appearance to jade is that named by the writer californite, a variety of compact green vesuvianite from Yreka, Siskiyou County, Cal., a stone almost as tough and as beautiful as the best jade, for which it was at first mistaken. Other ornamental stones from California were blue chalcedony (sapphirine) from Kern County, and chrysoprase from Visalia, Tulare County. A notable exhibit was that of the great crystals and masses of transparent quartz obtained some years since in Calaveras County, Cal., from which were cut, as shown in the case, rock crystal balls measuring from 2⅜ to 5⅞ inches in diameter.

Southern California, as has already been noted, is fast becoming known as one of the most remarkable gem regions in the world, rivaling the long celebrated treasure ground of the Ural Mountains. San Diego County, with its wonderful yield of gems, was more fully represented than any other part of the coast, notably in the splendid tourmalines from Mesa Grande and Pala—red, green, yellow, and bicolored crystals weighing several pounds, cut gems weighing up to 30 carats each, and sometimes single stones showing two or three distinct colors. The new gem mineral, kunzite, had the best display yet shown at any exposition. Another recent discovery in gem stones was shown in the fine topaz crystals of light-blue color from Ramona and Valley Center, San Diego County, the best topazes that this continent has produced. The beryls from the same region are also very interesting, one of the rarest varieties being pink beryl, found both at Pala and Mesa Grande. All these minerals were reviewed in the report of this Bureau for 1904, in the section on the gem minerals of California.[a] The special exhibit made by San Diego County attracted much attention and received a first-class gold medal.

As to the neighboring western States and Territories, a rich display was made from Arizona of the beautiful malachite and azurite specimens from the copper mines at Bisbee, Clifton, and Morenci; also of the elegant chrysocolla, coated with transparent crystals of quartz, from the Globe mine. Fine examples were shown of peridot (chrysolite) from the lately discovered locality for this mineral at Talklai, Ariz., one of these being a cut stone of 25¾ carats. Turquoise matrix, from Gila County, is a somewhat novel ornamental stone, the rock, traversed by small veins of turquoise, being cut and polished so as to produce a pleasing effect. Another ornamental stone, representing lapis lazuli and like that celebrated mineral adapted to choice uses in art work, is dark blue fibrous dumortierite from Clip, Yuma County, Ariz.

New Mexico was represented by specimens of turquoise and of the pyrope garnets from the Navajo nation, which are often miscalled rubies.

From Utah was shown the elegant green mineral utahlite, from the Floyd mining district in Clay Canyon. This substance is found only in Utah.

Wyoming was represented by fine pieces of moss agate in large polished slabs, from Hartville.

Among the most valuable gem materials shown from Montana were the beautiful blue sapphires from Yogo Gulch, Fergus County, which present a striking contrast to the varied colors of the sapphires found in the placer washings near Phillipsburg, Granite County. These latter are all obtained by sluicing, whereas in Fergus County sapphire is mined in solid igneous rock. Montana was also represented by some remarkable examples of amethyst and of smoky quartz found a few years ago in the Little Pipestone district, in Jefferson County.

The cut stones in the exhibit numbered altogether 90, and the uncut specimens 129, a total of 219.

Gem gathering in Ceylon.—Mr. A. K. Coomeraswamy, director of the mineralogical survey of Ceylon, has published a paper on the rocks and minerals of that island,[b] with special reference to the gems that have been gathered there from time immemorial. In the Report of the Mineralogical Survey for 1904[c] an extended account is given by Mr. Coomeraswamy and the assistant director, Mr. James Parsons, on the "gemming" industry of Ceylon. The gems of the island are all obtained from a widely distributed gravel or *illam*, with the exception of some garnets and the valuable Ceylonese moonstone, which latter is taken out by quarrying from an adularia-bearing leptynite, in the central Province. The gravels are now worked by washing in the Ratnapura district of Sabaramamuwa Province and in parts of the southern Province. Elsewhere they appear to have been exhausted, and the same fate is steadily approaching the regions that are still productive.

[a] Mineral Resources U. S. for 1904, U. S. Geol. Survey, 1905, pp. 961–985.
[b] Coomeraswamy, A. K., The Rocks and Minerals of Ceylon; Spolia Zeylanica, vol. 11, pt. 9, 1905, pp. 50–66.
[c] Administration Reports, 1904, Min. Surv., Ceylon, pp. E–11, E–19.

The gems found are corundum, spinel, zircon, iolite, topaz, tourmaline, beryl, and chrysoberyl, the latter in the varieties alexandrite and cat's-eye. The report goes into full details of the localities, the variations in the character, and the situation of the *illam*, the methods of working, etc., and is accompanied by two maps.

Precious stones in India.—Although India has long been associated traditionally with gems and gem production, it yields at present but a small part of the world's supply of such minerals. It is curious to find the statement made by the director of the Indian Geological Survey, Dr. T. H. Holland, in a recent report,[a] that all the gems produced in that country "do not approach in value the unset stones and pearls imported," which, during the period covered by his review (1898–1903), had an average value of over half a million of pounds sterling per year.

In this review a special section is given to gems, of which by far the most important are the rubies of Burma. The diamond occurrences are described almost exactly as given by Mr. Sarratt C. Rudra, and cited in the report of this Bureau for 1903.[b]

For the rest, a few notes are added here: The blue sapphires formerly obtained in the Kashmir State appear to have been exhausted of late, and no records are procurable.

Ruby spinel is a common associate of the true ruby in Burma both in the gravels and in the limestone rock, and is often mistaken for it.

Another Burma gem stone is the red tourmaline (rubellite), and some attempts have been made to work it, as it is of fine quality. The data of production, however, are very variable and imperfect. The value of the output was estimated at £1,240 in 1900, but was barely £200 in 1903.

There is considerable garnet production in Jaipur, in the mica schists of Rajmahal; also near Sarwar in the adjacent State of Kishengarh. Data from the former are not procurable, but the output from the latter varies widely, its value ranging from £2,000 to £10,000 per year.

Methods of rock and fossil section cutting.—A remarkable piece of work has lately been accomplished in the cutting of large and very thin sections of silicified cycads, by Mr. R. G. Wieland, of Yale University. This work, and the studies which it was designed to illustrate, are presented in a bulletin illustrated by 12 heliotype plates about to be issued by the Carnegie Institution.[c] The material consisted of the cycadaceous trunks of Jurassic and Cretaceous age, which have been found in some abundance within recent years in Maryland, Dakota, and Wyoming. Among the latter, especially, the details of structure are preserved in great perfection in the silicified mass, and it has been possible by this most careful and skillful piece of work to illustrate accurately the peculiar features of these fossils. The sections measure from 10 to 12 centimeters in length and from 6 to 10 centimeters in width. They are cut to the fineness of one-tenth to one-fifth of a millimeter, and polished on both sides and mounted on glass plates on balsam. Mr. Wieland believes that with time for the devising of further appliances, it will be possible to cut thin sections even from entire trunks.

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[a] Rec. Geol. Surv. India, vol. 32, pt. 1, 1905.
[b] Mineral Resources U. S. for 1903, p. 920; also Trans. Am. Inst. Min. Eng., New York Meeting, October, 1903, pp. 11–15.
[c] On the methods of section cutting.

PRODUCTION.

In the following table is given a statement of the production of precious stones in the United States from 1898 to 1905, inclusive:

Production of precious stones in the United States, 1898–1905.

Precious stone.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
Diamond	$300	$150	$100	None.	$50	None.	None.
Sapphire	68,000	75,000	90,000	$115,000	100,000	$100,000	$125,000
Ruby	3,000	3,000	500	None	None.	None.	None.
Topaz	None.	None.	None.	None.	200	None.	500
Beryl (aquamarine, etc.)	4,000	11,000	5,000	4,000	4,000	5,000	6,000
Beryl (pink)					200	100	1,000
Emerald	50	1,000	1,000	1,000	250	None.	None.
Phenacite	None.	None.	None.	None.	None.	None.	None.
Tourmaline	2,000	3,500	15,000	30,000	45,000	40,000	50,000
Peridot	500	500	500	500	5,000	5,000	10,000
Kunzite						10,000	5,000
Quartz, crystal	12,000	10,000	10,000	12,000	10,000	10,000	10,000
Smoky quartz	None.	1,000	1,000	2,000	1,500	2,000	3,000
Rose quartz	100	100	150	200	1,500	1,000	1,000
Amethyst	250	500	500	2,000	3,000	3,000	2,000
Prase	None.	None.	None.	None.	None.	None.	None.
Gold quartz	500	2,000	2,000	3,000	3,000	5,000	5,000
Rutilated quartz	50	50	50	100	100	None.	None.
Dumortierite in quartz	None.	None.	None.	None.	None.	None.	100
Tourmalinated quartz	None.	None.	1,000	None.	None.	None.	None.
Agate	1,000	1,000	1,000	1,000	2,000	2,000	2,000
Moss agate	1,000	1,000	500	500	1,400	1,500	1,500
Chrysoprase	100	100	1,500	5,000	1,500	6,000	5,000
Silicified wood (silicified and opalized)	3,000	6,000	7,000	7,000	5,000	5,000	5,000
Opal	None.	None.	None.	150	200	None.	None.
Garnet (almandite)	5,000	500	100	None.	None.	None.	None.
Rhodolite	None.	20,000	21,000	1,500	1,000	None.	None.
Garnet (pyrope)	2,000	1,000	1,000	1,000	2,000	3,000	5,000
Topazolite	None.	None.	None.	None.	None.	None.	None.
Amazon stone	250	250	200	500	400	500	1,000
Oligoclase	20	20	None.	None.	None.	None.	None.
Moonstone	None.	None.	None.	None.	None.	None.	None.
Turquoise	72,000	82,000	118,000	130,000	110,000	100,000	65,000
Utahlite (compact variscite)	100	100	250	None.	100	200	500
Chlorastrolite	3,000	3,000	3,000	4,000	3,000	2,000	3,000
Mesolite (thomsonite, so called)	1,000	1,000	1,000	1,000	500	500	500
Prehnite	50	50	None.	None.	None.	None.	None.
Diopside	None.	None.	None.	None.	None.	None.	None.
Epidote	None.	None.	None.	None.	None.	None.	None.
Pyrite	1,000	2,000	3,000	3,000	3,000	3,000	2,000
Malachite	250	200	100	None.	None.	None.	2,000
Rutile	200	100	None.	None.	None.	None.	None.
Anthracite (ornaments)	2,000	2,000	2,000	2,000	2,000	2,000	2,000
Catlinite (pipestone)	2,000	2,000	2,000	2,000	2,000	2,500	2,000
Fossil coral	50	50	100	None.	None	None.	250
Arrow points	1,000	1,000	500	None.	None.	None.	1,000
Miscellaneous						15,000	10,000
Total	185,770	233,170	289,050	328,450	307,900	324,300	326,350

IMPORTS.

Diamonds.—The diamond imports for the year 1905 amounted to more than the combined imports for the years 1897, 1898, and 1899. Especially noticeable is the fact of the greater importation of the rough material and the greater increase of the diamond-cutting industry in this country, the importation of the rough amounting to more than seven times as much as that of 1897, to almost three times as much as that of 1900, to about 25 per cent more than that for 1902, and to practically the same as for the years 1903 and 1904. The importation of precious stones for the month of December, 1905, was $3,633,379, as much as the importation of any entire year up to 1879.

The following table shows the value of the diamonds and other precious stones imported into the United States from 1901 to 1905, inclusive:

Diamonds and other precious stones imported and entered for consumption in the United States, 1901–1905.

Year.	Diamonds.					Diamonds and other stones, not set.	Total.
	Glaziers'.	Dust.	Rough or uncut.	Set.	Unset.		
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
1905	6,851	190,072	10,281,111	741	20,375,304	4,144,434	34,998,513

QUARTZ (FLINT) AND FELDSPAR.

By Heinrich Ries.

QUARTZ (FLINT).

PRODUCTION.

The production of quartz (referred to commercially as flint) in 1905 amounted to 39,555 short tons of crude quartz, valued at $33,409, and 11,590 short tons of ground quartz, valued at $70,700, a total of 51,145 short tons, valued at $104,109.

These values refer to the material at the mines, and the ground material includes only that ground by the producers.

The production for 1905 is given in the following table:

Production of quartz (flint) in the United States in 1905, by States.

[Short tons.]

State.	Crude.		Ground.	
	Quantity.	Value.	Quantity.	Value.
Maryland, Pennsylvania, and Connecticut	1,187	$2,750	11,590	$70,700
North Carolina and New York	38,368	30,659		
Total	39,555	33,409	11,590	70,700

A comparison of these figures with those for 1904 brings out the following facts: The production of crude quartz shows a decrease of 1,935 short tons in quantity and an increase of $4,519 in value, or, in other words, a higher average price per ton.

The production of ground quartz shows an increase of 810 short tons in quantity and a decrease of $1,000 in value.

The decrease in quantity of crude and ground quartz combined amounted to 1,125 short tons, with a reported increase of $3,519 in value. The quantity used for pottery purposes is decreasing, for the reason that many potters prefer ground silica sand, as it is usually freer from iron than the vein quartz considered in this report.

The production of quartz (flint) from 1901 to 1905 was as follows:

Production of quartz (flint) in the United States, 1901–1905.

[Short tons.]

Year.	Crude.		Ground.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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
1905	39,555	33,409	11,590	70,700	51,145	104,109

The figures of this table do not represent the entire quantity of quartz and flint consumed annually in the United States, for much flint is imported from Europe in the form of rounded stones for use in ball mills. The value of these imports in 1905 was $146,463, as against $94,803 in 1904. As yet no satisfactory domestic product has been found as a substitute for the imported flints.[a]

FELDSPAR.

PRODUCTION.

The production of feldspar in 1905 amounted to 14,517 short tons, valued at $57,976, and 20,902 short tons of ground feldspar, valued at $168,181, a total of 35,419 short tons, valued at $226,157.

These values refer to the material at the mines, and the ground material includes only that ground by the producers.

The production for 1905 is given in the following table:

Production of feldspar in the United States in 1905, by States.

[Short tons.]

State.	Crude.		Ground.	
	Quantity.	Value.	Quantity.	Value.
Connecticut, Maine, New York	10,501	$47,036	9,040	$60,500
Maryland, Pennsylvania	4,016	10,940	11,862	107,681
Total	14,517	57,976	20,902	168,181

A comparison of the figures for 1905 with those for 1904 brings out the following facts. The production of crude feldspar shows a decrease of 4,896 short tons in quantity and a decrease of $8,738 in value, which indicates a slight decrease in the reported average value per ton.

The production of ground feldspar shows a decrease of 4,873 short tons in quantity and of $31,431 in value, which, however, indicates an increase in the reported average value per ton. This decrease in quantity is believed to be more apparent than real, as full reports of production have not been received from at least one large producer in 1905. It does not appear that there is any falling off in the demand. On the contrary, the use of feldspar is increasing, but much of the consumption is supplied by Canadian spar which is imported in the crude form and ground at Trenton, East Liverpool, and East St. Louis.

No new localities were added to the list of producers in 1905, although some new firms began operations in Pennsylvania, and their production will appear in the 1906 statistics.

The production of feldspar from 1901 to 1905 is given in the following table:

Production of feldspar, 1901–1905.

[Short tons.]

Year.	Crude.		Ground.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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
1905	14,517	57,976	20,902	168,181	35,419	226,157

[a] See report on abrasives for 1905.

TALC AND SOAPSTONE.

By Joseph Hyde Pratt.

OCCURRENCE.

Talc is found in nearly every State along the Atlantic slope, varying from pure, foliated talc to harder steatite. Many of these deposits are very favorably located for transportation, so that it has been possible to work profitably many of the compact varieties of talc and soapstone in this section of the country. In the western States talc has been found in greater or less quantity at many localities, but on account of their great distances from railroad transportation only one or two of the deposits have been developed at all.

In some instances nearly all of the talc obtained from a certain State is used for one particular purpose, as that from New York, which is used almost exclusively as a filler in the manufacture of paper; and that from Virginia, which is manufactured into washtubs, laboratory sinks, stove bricks, etc. The States that have produced talc or soapstone are California, Connecticut, Georgia, Maryland, Massachusetts, New Hampshire, New Jersey, New York, North Carolina, Pennsylvania, and Vermont, and most of these deposits have been described in previous reports. The Vermont deposits were visited during the past summer, and are described here in some detail.

Vermont.—Talc and soapstone are found over a considerable area in Vermont, and deposits have been developed in Windsor, Windham, Rutland, Washington, and Lamoille counties, the greatest development being in Windsor and Rutland counties. In Windham County soapstone deposits have in former years been quite extensively worked in the vicinity of Cambridgeport, and during the past year a mill located at this point worked up waste material that had been taken out during previous mining. In the northwestern portion of this county, in Windham Township, on the farm of Mr. A. L. Stone, which is about 8 miles southwest of Chester village, Windsor County, a soapstone deposit has been located and partially developed. An outcrop of talc or talcose minerals was observed about 720 feet long and from 110 to 242 feet wide, with an average width of approximately 150 feet. This talc formation is bounded on the east by a chloritic schist for practically its entire length, and on the west by a serpentine, which in turn is bordered by a mica schist or gneiss. The broader portion of the soapstone is to the south, where it seems to cut out the serpentine, and comes apparently in contact with the chlorite schist, although the direct contact could not be observed. To the north the soapstone begins to narrow, and where it disappears under the loose soil and alluvium it measures about 100 feet in width. The general direction of the major axis of this outcrop of talc is N. 10° W. The development work on the property consists of a quarry which has been opened on the west side of the outcrop and near the northern end, for a length of 30 feet and a width of 20 feet, the face of the quarry varying from 10 to 15 feet in height. Only a very small portion of the soapstone exposed in this quarry is suitable for manufacturing into sinks, tubs, etc. Although it saws well, the large slabs when handled have a tendency to break quite readily. This stratum extends to within a few feet of the eastern boundary of the deposit, where it is in contact with a decidedly green, foliated talc, which has been exposed at a number of places close to the eastern boundary. At a point about 62½ feet southeast from the northern edge of the quarry a hole 35 feet deep was bored, which gave a 5-inch core and showed the following sequence: The first 22 feet are similar in character to the material exposed in the quarry, except that with greater depth it is freer from grit. The next 8 feet indicate a first grade talc. From 30 feet on, the hole penetrates a layer that contains a little grit and is similar in appearance to the upper layer, although it would represent a purer form of talc. If the 8-foot layer of talc averages like that shown in the core, it would be suitable for grinding into powder for the manufacture of talcum powders and other purposes for which the fine grades of talc are desired. In the mass it is of a pale bluish gray or green color, but grinds perfectly white. Although there has not been any large amount of development work undertaken on this property, still what has been done shows that the talc is extensive and in certain portions of the area of first-rate quality, which may be proved by exploration to extend over a large portion of the deposit. The chief obstacle to the commercial development of this property is its distance (8 miles) from the railroad.

Three miles nearly southwest of Chester village and about 700 feet higher than the village are deposits of soapstone belonging to the Union Soapstone Company that are being very extensively worked. The soapstone occurs in seams or lenses bounded by a gneissic rock; they dip sharply to the southeast and strike nearly north and south. The lenses of soapstone also pitch toward the south. A thin seam of actinolite often occurs above the soapstone, between it and the gneiss. The soapstone has been opened by means of two cuts, the north one being 100 feet long by 70 feet wide and about 60 feet deep. The south cut or pit is 50 to 60 feet long, about 30 feet deep, and 60 to 70 feet wide. The openings follow the pitching and dipping of the seams of soapstone under the gneiss, and although they have penetrated under it for some distance there is no timber used to support the roof. Although large masses of roof fall during the winter seasons and in early spring, there is but little trouble experienced with it during the working season. The blocks as they are quarried are hoisted to the surface and culled, and then hauled by teams to the company's mill, on the railroad at Chester depot. Some of the soapstone obtained is of very good quality, but a large proportion of it is badly cracked, so that there is a large waste in obtaining a sufficient supply for the uses of this company. The plant is well equipped for manufacturing tubs, griddles, warmers, etc., and also for utilizing the waste product by grinding into powder for various purposes. The American Soapstone Finish Company also have a mill at Chester depot for grinding soapstone, which they use in the manufacture of soapstone mortar and plaster.

Ten and 12 miles northwest, north, and northeast of Chester depot soapstone deposits have been opened up along a line running from Ludlow to Perkinsville, Windsor County. At the present time the only deposit that is being operated is that at Perkinsville. The quarry is 1¼ miles west of the village and about 300 feet above the river. The occurrence of the soapstone here is very similar to that at Chester, the soapstone being bounded by gneissic rocks. The Vermont Soapstone Company, which owns these quarries, has its mill located in the village of Perkinsville, where the soapstone is sawed and manufactured into various articles.

Some of the most extensive workings on soapstone are on the property of the New England Talc Company, which is about 1¾ miles northeast of Pittsfield, Rutland County, and near the summit of a hill rising about 500 feet above the Pittsfield-Stockbridge road. Soapstone was first discovered here by Mr. Frank Durkee as a very small outcrop on the surface and was followed downward for fifty-odd feet by means of a shaft. It was sold to the New England Talc Company about 1897. They have developed this property very extensively, first by running in a cut below the first shaft, part of this cut being through the country rock, a biotite gneiss. The total length of the cut was 132 feet, and the work showed that the soapstone was occurring in lenses dipping downward in a general northeast direction. Another cut was started still farther down the side of the mountain and 50 feet below the upper cut, which was continued as a tunnel for a distance of 150 feet and showed the talc lens to become wider and more extensive as it was followed downward, indicating that the outcrop exposed was practically an apex or terminus of a lens. About two-thirds of the distance in this cut or tunnel a shaft 150 feet deep has been sunk, from which a drift has been run N. 10° E., following the strike of the soapstone lens. At the time this property was visited the mine was not being worked and the drift and part of the shaft were filled with water, the information obtained regarding it being given by Mr. Frank Durkee. The mine was closed down early in the spring of 1905, and, according to a statement made by the company, the lens of soapstone had begun to narrow down very materially in the drifts, this pinching out of the vein being the reason for the shutting down of the mine. It is not improbable that other lenses or seams of soapstone would be developed by further exploration work; but there has not been sufficient work done for any positive statement regarding this. The talc, as mined, was transferred from the shafthouse to the storehouse on the road by means of an aerial tramway 2,400 feet long. This material was then shipped to the company's mill at Arlington, Mass. Mr. Durkee reports that similar deposits of soapstone have been found across the valley in a S. 20° W. direction, on what is known as South Hill. This property, however, has been developed but very little.

One mile west of Stockbridge, about 350 to 400 feet above the railroad track and about 2,200 feet from it, is a deposit of soapstone belonging to the Pilgrim Talc Company, of Boston, Mass. This property was originally worked, between 1870 and 1875, for soapstone for local purposes. Of the soapstone exposed very little was observed that could be used in the manufacture of tubs or for cutting into slabs, as there were numerous small seams of foliated talc running through it. There are, however, considerable portions of this talc deposit that are of sufficient purity to be used for grinding into a powder. The property was first operated for this purpose in 1895, but was only worked for a short time. In 1902 it was again opened and work continued spasmodically until the spring of 1904, at which time the last work was done. The talc and soapstone seem to be associated with a mass of serpentine about 48 feet wide, the former mineral occurring on both sides of the serpentine and between it and the gneissic country rock. The quantity of talc and soapstone is not as extensive as in many of the other deposits visited. About a quarter of a mile to the north of this mine soapstone again outcrops and is probably a continuation of that already developed.

Other localities in Vermont where talc is known to occur in some quantity and of good quality are in the vicinity of Moretown, Washington County, near Waterville, Lamoille County, and near Rochester, Windsor County.

New Jersey.—In the annual report of the State geologist of New Jersey for 1904,[a] a description of the talc deposits around Phillipsburg of that State and Easton, Pa., is given by F. B. Peck. Material suitable for grinding has been found at 16 places. Of these 10 have been opened by quarries, of which 4 were worked regularly and 2 intermittently during 1904. In some of these a superior grade of serpentine for interior decorations is also found. The talc is manufactured into "mineral pulp" and is used for various purposes, as the manufacture of mineral paint, heat resisting wall plaster, adulterant for cheaper soaps, manufacture of rubber goods, and as a paper filler.

The talc occurs with serpentine in dolomitic beds in the vicinity of early pegmatite intrusions. The last utterly changed the portions of the original limestone or dolomite with which they came in contact to the silicates, tremolite or white pyroxene, or caused the formation of much phlogopite mica in the dolomite. During the break-thrust faulting, with accompanying minor folding, squeezing, and faulting to which the region has been subjected, the magnesian silicate minerals were altered by the hydrating and leaching power of the ever present water to their present condition.

Similar conditions of occurrence are found at Montville, Morris County, where serpentine is quarried.

North Carolina.—Soapstone deposits that may prove of value when railroad facilities are to be had are located about 2 miles west of Beaver Creek, Ashe County, N. C. At several places quarries have been opened and good material obtained for local use in fireplaces, etc. The individual deposits are lens-shaped masses, with a thickness up to several feet, lying in the inclosing schists or associated with other less altered peridotites. These lenses show very few fractures or joints, and seem capable of yielding tough, good-sized blocks or slabs. The soapstone saws readily, even though it carries a good deal of only partly altered asbestiform tremolite.

The demand for talc for grinding and also for cutting into pencils, gas tips, etc., is constantly increasing, and at the present time the domestic production is not equal to the demand. This scarcity has caused an increase in the price of talc suitable for gas tips, electrical insulators, burners, pencils, etc., and now there is a considerable quantity of Bavarian steatite or soapstone imported to satisfy this domestic demand. Hence any new property is worthy of investigation, and many of the larger producers of talc, and especially the manufacturers of the articles mentioned, are on the lookout for deposits of talc suitable for their purposes.

PRODUCTION.

During 1905 the total production of talc and soapstone of all varieties amounted to 96,634 short tons, valued at $1,082,062, an increase of 5,445 short tons in quantity and of $141,331 in value, as compared with 91,189 short tons, valued at $940,731, the production of 1904. This increase is due to the large increase in the productions from Virginia and Vermont.

PRODUCTION IN ALL STATES, EXCLUSIVE OF NEW YORK.

The production of 1905 in all of the States, exclusive of New York, was 40,134 short tons, valued at $637,062, an increase of 12,950 tons in quantity and of $203,731 in value, as compared with the production in 1904, which amounted to 27,184 short tons, valued at $433,331. Of the total quantity of talc mined or quarried but a small proportion is sold in the crude state, and the values given

[a] Ann. Rept. Geol. Survey, New Jersey for 1904, 1905, p. 161.

represent the value of the talc in the condition in which it is marketed. In the following tables of this report the production is classified as it is marketed, as rough, sawed into slabs, manufactured articles, and ground talc. The greatest variation will be noticed in the value of the manufactured articles, which is due to the character of the articles made, some years the articles manufactured being much more expensive than in other years, though the tonnage of talc used may be approximately the same. In the following tables there are given the production and value of the talc and soapstone produced in the United States (exclusive of the State of New York) from 1902 to 1905, inclusive, according to the condition in which it was marketed.

Production of talc and soapstone, 1902–1905.

[Short tons.]

Condition in which marketed.	1902.		1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Rough	2,816	$20,036	2,908	$23,704	1,815	$9,270	1,625	$10,483
Sawed into slabs	436	7,722	2,027	33,800	3,850	64,276	4,779	80,879
Manufactured articles [a]	13,476	412,028	12,219	274,978	11,990	283,373	14,665	403,660
Ground [b]	10,126	85,371	9,517	85,978	9,529	76,412	19,065	142,040
Total [c]	26,854	525,157	26,671	418,460	27,184	433,331	40,134	637,062

[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.

With the exception of talc marketed in the crude state, there was a decided increase in the quantities of all the other forms of talc marketed. Of the talc sawed into slabs, practically all was from Virginia, and the quantity is the largest reported in any year during the last thirteen. The quantity of manufactured articles made in 1905 was considerably more than in 1904, with a large increase in value. Nearly half of the ground talc was from material obtained from Vermont. The price of the ground talc sold in 1905 varied from $5 to $12 per ton, while in 1904 it varied from $6 to $13 per ton. The highest prices were received for North Carolina ground talc.

The 1905 production of talc and soapstone was obtained from 10 States, which are as follows, given in the order of the value of their production: Virginia, North Carolina, Vermont, New Jersey, Georgia, Pennsylvania, Massachusetts, Washington, Maryland, and California. In 1904 the number of producers in each State were as follows, given in the order of their production: Virginia, 2; North Carolina, 5; Vermont, 3; New Jersey, 1; Pennsylvania, 2; Georgia, 2; California, 1; Washington, 1; Massachusetts, 1. As there was only one producer in several States, it has been necessary to group them together in giving the production by States.

Production of talc and soapstone in 1904 and 1905, by States, exclusive of New York.

[Short tons.]

State.	1904.		1905.	
	Quantity.	Value.	Quantity.	Value.
New Jersey and Pennsylvania	6,233	$35,755	5,796	$38,241
North Carolina and Virginia	17,625	339,928	21,700	499,780
Massachusetts and Vermont	1,900	44,200	10,188	75,405
Other States[a]	1,426	13,448	2,450	23,636
Total	27,184	433,331	40,134	637,062

[a] California, Washington, and Georgia in 1904, and California, Georgia, Maryland, and Washington in 1905.

Production of talc and soapstone in 1898, 1899, 1900, and 1901, by States.

[Short tons.]

State.	1898.		1899.		1900.		1901.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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.

PRODUCTION IN NEW YORK.

On account of the large production of fibrous talc from New York, which amounts usually in quantity to nearly double the talc 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.

The New York talc deposits situated to the east and southeast of Gouverneur were recently described by Robert B. Brinsmade.[a] They lie in beds of tremolitic limestone, which run conformably with the (hornblendic) gneisses and related schists of the region. They are included in a range about 7 miles long and 1 mile wide, in which parallel belts are indicated by several occurrences. Beds of a workable thickness of 12 to 15 feet are common, while at Talcville a workable thickness of 70 feet has been found in places. The talc was formed by circulating waters carrying carbonic acid acting on beds of tremolite schist in the limestone. The tremolite thus became hydrated and lost its calcium, which was carried off in solution as the carbonate. The beds of tremolite schist would have formed by the metamorphism and recrystallization of a highly siliceous dolomitic limestone.

[a] Eng. and Min. Jour. Dec. 23, 1905.

The veins dip at various angles—from 30° to 60° northwest. They are opened by inclines, generally along the foot wall, the greater part of the vein being removed overhead. At suitable intervals levels are run out on either side, and from these upraises are made to the level above. With the exception of the necessary pillars (25 to 35 feet square) and a foot or so left as a roofing, the talc is stoped out clean between levels. The product is hoisted from the mines by engine hoists and incline tracks. The levels are carried out as far as it pays to tram the talc to the incline.

In the mill the talc is put through a number of crushing operations. The final grinding is effected in Alsing cylinders which use stream flint pebbles from Greenland and Labrador.

In 1905 the production of fibrous talc in New York amounted to 56,500 short tons, valued at $445,000, as compared with 64,005 short tons, valued at $507,400, in 1904, a decrease of 7,505 tons in quantity and of $62,400 in value. The average price per ton in 1905 was $7.88 as compared with $7.92 in 1904, and with $7 in 1903, a decrease of 4 cents per ton from 1904 and an icrease of 88 cents per ton as compared with 1903. In the table below is shown the production of fibrous talc in New York since 1903.

Production of fibrous talc in New York in 1903–1905.

[Short tons.]

Use.	1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Paper filling Paint Wall plasters	60,230	$421,600	64,005	$507,400	56,500	$445,000

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, 1880–1905.

[Short tons.]

Year.	New York.		All other States.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1880-1900	629,925	$5,933,501	340,003	$5,291,151	969,928	$11,224,652
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
1905	56,500	445,000	40,134	637,062	96,634	1,082,062

As appears from this table the value of the 1905 production is greater than that for any year except 1902 since the statistics have been collected, although the tonnage was exceeded in the years 1901 and 1902.

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 1901 are given in the following table:

Talc imported into the United States, 1901–1905.

[Short tons.]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1901	2,386	$27,015	1904	3,268	$36,370
1902	2,859	35,366	1905	4,000	48,225
1903	1,791	19,677			

CANADIAN PRODUCTION.

There is but little talc produced in Canada, and the product varies widely from year to year in both tonnage and value. As reported by the geological survey of Canada, the output in 1905 was 500 short tons, valued at $1,800, as against 840 short tons, valued at $1,875, in 1904, and 688 short tons, valued at $2,064, in 1903.

NOTE ON TIMBER USED IN THE MINES OF THE UNITED STATES IN 1905.[a]

The statistics of the timber used in the mines of the United States in 1905, based upon data gathered in cooperation by the United States Geological Survey and the Forest Service, show that 5,163 mines reported the use of 165,535,900 cubic feet of round timber and 435,944,000 board feet of sawed timber, equivalent to a total of 2,422,374,800 board feet, valued at $16,455,887.

Classified according to kind of mine, the record is as follows: The bituminous coal mines of the country used 91,309,700 cubic feet of round timber and 140,790,000 board feet of sawed timber, valued at $6,379,931; the anthracite coal mines of Pennsylvania, 43,676,000 cubic feet of round timber and 101,210,000 board feet of sawed timber, valued at $4,433,125; the mines for precious metals, 15,282,500 cubic feet of round timber and 164,956,000 board feet of sawed timber, valued at $4,405,690; the iron mines, 13,484,000 cubic feet of round timber and 13,929,000 board feet of sawed timber, valued at $914,449; and miscellaneous mines used 1,783,700 cubic feet of round timber and 15,059,000 board feet of sawed timber, valued at $322,692.

The cost of timber used in the mines in 1905 exceeded half a million dollars in each of eight States, as follows: Pennsylvania, $6,739,755; Montana, $1,329,853; Arizona, $1,034,614; Illinois, $778,186; Michigan, $746,987; West Virginia, $561,061; Colorado, $605,239; California, $503,124. The timber used by 754 mines in Pennsylvania amounted to 47,606,500 cubic feet of round timber and 157,324,000 board feet of sawed timber, having a total value five times that of the timber used in the mines of any other State. In Montana 153 mines for precious metals and bituminous coal used 4,008,400 cubic feet of round timber and 62,852,000 board feet of sawed timber. In Arizona 139 precious-metal mines required 1,045,500 cubic feet of round timber and 40,498,000 board feet of sawed timber. It is the high cost rather than the large quantity of the timber that gives Arizona such a prominent place, for the quantity used was actually less than that given for any other one of the eight States. In Illinois 400 soft-coal mines required 10,342,300 cubic feet of round and 7,025,000 board feet of sawed timber.

[a] Kellogg, R. S., Timber used in the mines of the United States in 1905: Forest Service circular 49, 1906.

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